H641-12

KISSIMMEE RIVER/LAKE OKEECHOBEE/ EVERGLADES ECOSYSTEM

(100-66)

HEARING

BEFORE THE

SUBCOMMITTEE ON WATER RESOURCES

OF THE

COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION

HOUSE OF REPRESENTATIVES

ONE HUNDREDTH CONGRESS

SECOND SESSION

MAY 20, 1988, FORT LAUDERDALE, FL

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KISSIMMEE RIVER/LAKE OKEECHOBEE/ EVERGLADES ECOSYSTEM

FRIDAY, MAY 20, 1988

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON WATER RESOURCES,
COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION,
Fort Lauderdale, FL.

The subcommittee met, pursuant to notice at 1:26 p.m., in room 206-A, Broward County Federal Building, 299 East Broward Boulevard, Fort Lauderdale, FL, Hon. Henry Nowak (chairman of the subcommittee) presiding.

Present: Representatives Nowak, Stangeland, Shaw and Bentley.

Mr. NOWAK. The subcommittee will come to order. This afternoon, gentlemen and ladies, we are here to hear and meet and receive your testimony concerning the Kissimmee River, Lake Okeechobee, Everglades ecosystems. We will hear about the relationship between surface and ground water in the ecosystem, threats to the ecosystem, current and future plans for management of the ecosystem, and initiatives to protect the ecosystem. Testimony will be received from Federal and State agencies and environmental interests.

At the center of the ecosystem is Lake Okeechobee. It serves as a balancing reservoir for the ecosystem, receiving inflow generally from the north, primarily the Kissimmee River, and then releasing outflow to the Atlantic Ocean, Gulf of Mexico and the Everglades. The Kissimmee River was once a shallow, meandering river, but channelization work in the 1960's completely regulated its flow, resulting in the loss of 70 to 80 percent of the basin's 40,600 acres of wetlands, the loss of fish and wildlife habitat, and upland and floodplain drainage which degraded the water quality entering Lake Okeechobee.

The primary water quality threat to Lake Okeechobee appears to be the excessive nutrient loadings resulting in the excessive growth of algae and aquatic plants. The nutrients, primarily phosphorus and nitrogen, are traceable to fertilizers used for agriculture and animal wastes from beef and dairy cattle herds. The nutrients are causing algae blooms in Lake Okeechobee and cattail marshes in the Everglades. Both of these growths alter the microscopic life of the water by drawing away dissolved oxygen which threatens all species which rely on the ecosystem. Today's witnesses will speak to the nutrient problem.

The ecosystem has been affected by the U.S. Army Corps of Engineers Central and Southern Florida Project for flood relief and

water conservation. While the project has been successful in reducing flood damage and conserving water, it eliminated the historical sheet flow of water which previously supplied water to the Everglades. Today we hope to learn more about possible modifications to the water delivery schedule to improve water flow to the Everglades.

To discuss the issues facing the Kissimmee River, Lake Okeechobee and the Everglades, we have a distinguished group of witnesses. We will begin with presentations of four federal agencies who will describe the situation and the past, present and future efforts involved in this area. We will then hear from state and local government officials and citizen and environmental groups.

Before we begin with our first witness, I would like to yield to the distinguished ranking minority member of the Subcommittee, Arlan Stangeland, for whatever remarks he wishes to make.

But just prior to that, I want to mention that we are here at the invitation of Clay Shaw, who is a member of the committee and subcommittee, and has informed us about this problem for many, many months as well as other water related problems in southern Florida. I think this morning's trip was very helpful for us who have never had the opportunity to go over in a plane to see the whole system as it actually exists today, and to see what changes are anticipated. For that we thank him and the Corps for arranging that trip.

Let me now turn to Mr. Stangeland.

Mr. STANGELAND. Thank you, Mr. Chairman. First of all I am pleased to be here today as the Subcommittee gathers crucial information on water quality and quantity problems in the Lake Okeechobee/Kissimmee River ecosystem. First let me commend my colleague Clay Shaw for his leadership on this and other Florida water resource issues. Clay has shown a genuine interest in and a commitment to solving Florida's water problems over the years. As one of Public Works and Transportation's seasoned veterans, he has kept a close eye over Florida's water use, quality and quantity needs. Today's hearing on Lake Okeechobee and the Kissimmee River is just one example.

Actually today's hearing is in many ways a followup to legislation introduced by Congressman Shaw and Congressman Lewis of this general area, and that was passed by the House of Representatives last December. Congress incorporated their bill, H.R. 3244, into a comprehensive groundwater research and protection bill. Their proposal would require the Environmental Protection Agency to coordinate with the Corps of Engineers in establishing a demonstration program to combat groundwater problems and excessive weed growth.

As all of you know, however, various other challenges confront the ecosystem and that is why we are here today. We hope to educate ourselves about the wide range of issues involving water pollution, water supply and the way of life for residents and users of Kissimmee, Okeechobee and the Everglades.

I represent northwest and central Minnesota, an area that stands in stark contrast to south central Florida in many respects. At the same time though, we have much in common. Minnesotans have serious concerns about nonpoint source pollution such as

runoff containing excessive nutrients, groundwater quality and wetlands protection. So do various groups, officials and lake users in the Okeechobee/Kissimmee region.

Today, we hope to learn more about these and other special environmental issues in the ecosystem. Our federal agency witnesses should provide useful overview of their roles, while state and local government officials and other witnesses should add the needed particulars and nuances of this complex situation we find ourselves in.

With that, Mr. Chairman, let me close so we can begin to receive this vital testimony as soon as possible. Thank you.

Mr. NOWAK. Thank you very much. Let me now turn to Mr. Shaw, who is responsible for the committee coming to southern Florida and looking at this enormous problem. Mr. Shaw.

Mr. SHAW. Thank you, Mr. Chairman. I would like to thank you as chairman for coming down to south Florida, and welcome you, together with Mr. Stangeland and Helen Bentley from Maryland, to our district here in south Florida. If you would have come down from your home in Buffalo in February, perhaps I would not be quite as grateful to you, or you Mr. Stangeland from Minnesota or Helen coming down from Maryland. But to come down at the time of the year, it is strictly business. We flew in last night and I very much appreciate you doing that for me and for the people here in south Florida.

The whole Kissimmee River south through Lake Okeechobee and into the Everglades is of very vital concern and immediate interest to the people all over south Florida. We depend very heavily upon our drinking water from this whole setup. We have found out that going from the early days of the 1920's, 1930's and through the 1940's when the whole objective was to reclaim land and drain the swamps, we finally found that this is not really the way to go and that we are fooling around with Mother Nature and Mother Nature sometimes come around to bite you.

We are seeing signs of an abused ecological system right now. We think—we feel that we still have time to react to it and act responsibly. A lot more research has to be done, there is a lot of conflicting testimony and conflicting ideas out there. The federal government, along with and in partnership with the state government, has a very vital interest, being the largest landowner in the south Florida area with the Everglades property, and more particularly that which is in the park. Much of the property in south Florida, as we saw on our aerial tour today, is state and federally owned. So with the Corps of Engineers, the work that they have done in the past and the work they are capable of doing for south Florida, there is a real federal interest, and again I want to express my deep appreciation to you two gentlemen and lady for coming down to this hearing.

So that I not forget, I would like at the outset to thank Judge Gonzales for making his chambers available to us today.

Thank you, Mr. Chairman.

Mr. NOWAK. Thank you very much. As you know, we were scheduled in February, but I did not want to leave the good weather to come to Fort Lauderdale.

Let me now come to another very dedicated member of this subcommittee, who has a great interest—of course her district is in the Chesapeake Bay area where she has also encountered terrific problems along the same nature as we are looking at down here, and yet vastly different in the approach if we are going to solve these enormous problems—Mrs. Helen Bentley from Baltimore County.

Mrs. BENTLEY. Thank you, Mr. Chairman. I also want to join in commending you for your leadership in the whole groundwater and polluting of our important waterways. I want to commend also Mr. Shaw for his leadership in Florida, as it should be. He has done an outstanding job on it.

Mr. Stangeland pointed out that there were some relationships between Minnesota waters and the lake down here. We have them with the Chesapeake Bay, too, as the chairman just said. Nonpoint source pollution has been a serious pollutant of Chesapeake Bay for many, many years and there is a big drive today to see what we can do to stop that. I think the legislation, clean water legislation and the groundwater legislation that this committee has been the leader on, at the behest of the chairman and Mr. Stangeland, is going a long way to eradicate some of these problems but it just takes so much time and we have to push it along as fast as we can.

I might note, Mr. Chairman, that our Governor on Sunday is having a big tree planting ceremony. We are trying to get a million trees planted around Chesapeake Bay to help stop the nonpoint source pollution. It is interesting to note that for many, many years, you know, everybody cut down all the trees, they destroyed them. And much to everybody's surprise to learn later that the trees actually contribute a great deal in keeping water areas like Lake Okeechobee and Chesapeake Bay clean. And so they are—we have that big drive going on.

And I also, this past Monday, was up on some farmland in my area to see what the agriculture and Soil Conservation Service is doing to help prevent the flooding or the pouring into our waterways of the nutrients, the fertilizers that have been so destructive to systems such as Kissimmee River and Lake Okeechobee and Chesapeake Bay, and I must say that this is—again, I am very pleased with the legislation that is leading to that.

Again, time is of the essence and I cannot push it too hard too soon. I will ask unanimous consent, Mr. Chairman, to prepare a written statement to be included.

Mr. NOWAK. Without objection, your statement will be admitted.

[The statement of Mrs. Bentley follows:]

STATEMENT OF REPRESENTATIVE HELEN DELICH BENTLEY

Chairman Nowak and Ranking Minority Member, Mr. Stangeland, I commend both of you for arranging today's subcommittee field hearing on the Kissimmee River/Lake and Okeechobee/Everglades Ecosystem. It is a pleasure to participate in today's hearing and to be in the congressional district of our distinguished colleague, Mr. Shaw. I am particularly interested in receiving the testimony presented here on the environmental problems associated with Kissimmee, Lake Okeechobee, Everglades ecosystems. These environmental problems are closely related to the same issues faced by my home state of Maryland in dealing with the water quality of the Chesapeake Bay.

My service to the Subcommittee on Water Resources has been helpful in preparing legislation designed to address some of our nation's water quality problems. During the 99th Congress, we were very active in preparation of reauthorization of

the clean water bill designed to provide necessary federal funding throughout the nation to improve our most precious and valuable natural resource, water. Restoration and maintenance of our natural resources are imperative for the well being of future generations.

Most of Florida is surrounded by water but maintaining a water supply that is drinkable and usable by the state's population is a tremendous and important task. It requires the participation of not only the government but also from private sources.

We in Maryland have been successful in our efforts to address the water quality problems of the Chesapeake Bay through contributions made by private industries directly affected by the water quality of the Bay. Local, regional, state and federal involvement has also contributed to our Bay restoration effort. This is an ongoing project. The Baltimore Regional Planning Commission has been active in preparing measures to combat the release of nonpoint source pollution into the Upper Chesapeake Bay. Nearly half of the pollutants entering the Bay is a result of nonpoint source pollution and it is important to reduce this water pollution.

The Mid-Atlantic region includes Maryland, Pennsylvania, Virginia, and the District of Columbia of our nation's capitol. This region has been significantly helpful in pulling our resources together to restore the Chesapeake Bay. The geography of Florida does not permit the state to seek assistance from neighboring states but other similar forms of assistance such as private industry is available and encouraged. aged.

The population of Florida has increased significantly and this increase has added to the need to provide water to this important area of our country. As with any heavily populated region of our country, particular emphasis must be given to providing direction that ensures that the environment must be preserved when making geological designs for public works projects. I believe today's congressional field hearing will contribute to making sound decisions for the best interests of this area's ecosystem.

I look forward to the following testimony and offer my full attention and assistance in this important matter.

Mr. NOWAK. Let me, at the outset, before we go into our federal panel here, mention that we will of course take the testimony we received in your complete written statement and incorporate it in the record back in Washington, and we will have the opportunity to talk to the other members of the subcommittee and the committee who could not be here today to bring out the highlights, and we hope that they will also give the same attention as the members here who have come down today.

We have a statement for the record from Senator Graham of Florida.

[The statement of Senator Graham follows:]

STATEMENT OF SENATOR BOB GRAHAM

Mr. Chairman, members of the Subcommittee, I regret that I cannot be with you in Florida to address you personally on the problems facing the Everglades ecosystem, as well as on steps we are taking to mitigate and prevent these problems. I appreciate your foresight in holding a hearing on this precious system. I particularly want to thank Congressman Shaw for his interest and efforts in this regard. In light of my absence, I appreciate the opportunity to submit testimony for the record.

Each year we see our dream of the Florida Everglades move closer to the reality of a permanently healthy and naturally functioning ecosystem—a secure preserve for rare and endangered species—a pristine source of replenishable fresh water—a unique place in all the world that is ours to safeguard and to restore.

As Governor of the State of Florida, I initiated the "Save Our Everglades" program in August of 1983. During these first five years, we have witnessed vast improvements in restoring water flow to a more natural state, protecting the endangered Florida Panther, restoring the Kissimmee River, and tackling the many problems plaguing Lake Okeechobee.

We have seen "best management practices" being implemented in the agricultural operations in the Taylor Creek-Nubbin Slough Basin and the Lower Kissimmee Basin above Lake Okeechobee. Backpumping of excess water removed from the Ev-

erglades Agricultural Area south of the lake has been reduced dramatically since 1985, while additional solutions are being examined for addressing lake pollution.

The conversion of Alligator Alley to Interstate 75 is underway. The plans include 36 animal and panther underpasses to allow safe movement from one side of the road to the other. The State is paying the total cost of 25 of these crossings. Other design features will allow improved overland sheet flow of water through the Big Cypress Swamp. A Panther Recovery Plan has been published, and extensive radio tracking, field investigation, biomedical research, and enforcement efforts are being conducted.

Legislation was recently enacted to add 146,000 acres to the Big Cypress National Preserve. This significant accomplishment will protect valuable habitat for the Florida Panther and will also provide a buffer north of Everglades National Park, allowing for more natural water flow. We are now reviewing various methods of acquiring the land for public use.

Acquisition of East Everglades land in an effort to expand the Park is looking increasingly workable. I am coordinating with the State Commission studying acquisition. An assessment of an expansion of the Park eastward will show us whether a more generous border will help maintain adequate water flow into the Park and prevent pesticide residues from entering the ecosystem. I stand prepared to draft appropriate legislation expanding the boundaries of the Park, based on the Commission's final recommendations.

We cannot stop now. We have just begun to make a dent in a life-long effort to restore the Everglades ecosystem. I have made the pursuit of these efforts one of my major legislative goals in 1988. I have requested $5 million for the restoration of the Kissimmee River. The canal systems which bring water to the Everglades need to be closely monitored. So does the Laxahatchee Wildlife Refuge South of Lake Okeechobee. Each piece of this complex puzzle is important and sensitive. We have to build in legislative safeguards for every habitat and water source and flow pattern.

It isn't a simple ecosystem and it isn't easy to protect—but it is possible. We have to be committed and vigilant. In the final analysis, we have to consider what kind of world we want to live in and to leave for our children. Do we want a Florida without panther tracks in the mud or the glorious sight of a Great Blue Heron stretching its wings? Do we want ever-increasing shortages of fresh, clean water for our cities? Do we want a shrinking Cypress forest and the extinction of hundreds of wild orchids?

If we want to preserve and protect all that we've been given, our efforts will determine how successful we are. We can save the Everglades and protect a priceless environment we cannot afford to live without.

Thank you again, Mr. Chairman and members, for your efforts in protecting this unique resource and affording me this opportunity to submit testimony.

Mr. NOWAK. This morning we viewed the Kissimmee River from an airplane. We did have opportunity to see a great deal in a very short time, and again I thank the Corps for arranging that kind of a very intense look at all the parts of this very, very complex ecosystem that you have here.

With that, let us move into our United States—the Federal panel here. We have from the U.S. Geological Survey, Mr. Lewis Ducret who is the chief of the Miami Subdistrict Office and Mr. Mike Finley, who is the superintendent of the Everglades National Park. What I think we will do, gentlemen, we will go through the rest of the Federal panel and then go back and get your direct testimony so that we will have the opportunity to ask questions of the total panel and perhaps reference over to another agency's work in that period and we will have you all here.

From the U.S. Fish and Wildlife Service, Mr. Warren T. Olds, Assistant Regional Director for Fish and Wildlife Enhancement and Mr. David Ferrell, a field supervisor of the Vero Beach Field Office.

From the U.S. Army Corps of Engineers, Mr. Steven Dola, who is the Deputy Assistant Secretary of the Army (Civil Works) for Management and Budget.

And from the U.S. Environmental Protection Agency, Mr. Lee DeHihns who is Deputy Regional Administrator of Region 4 and Mr. Mike McGhee, who is the chief of the Water Quality Management Branch in the Water Management Division of Region 4.

Mr. Ducret, if you would like to start your testimony, we could then move right through all of the direct testimony before we get into a short question period.

TESTIMONY OF G. LOUIS DUCRET, CHIEF, MIAMI SUBDISTRICT OFFICE, U.S. GEOLOGICAL SURVEY, ACCOMPANIED BY MIKE FINDLEY, SUPERINTENDENT, EVERGLADES NATIONAL PARK; WARREN T. OLDS, ASSISTANT REGIONAL DIRECTOR FOR FISH AND WILDLIFE ENHANCEMENT, U.S. FISH AND WILDLIFE SERVICE, ACCOMPANIED BY DAVID FERRELL, FIELD SUPERVISOR, VERO BEACH FIELD OFFICE; STEVEN DOLA, DEPUTY ASSISTANT SECRETARY OF THE ARMY (CIVIL WORKS) FOR MANAGEMENT AND BUDGET, U.S. ARMY CORPS OF ENGINEERS AND LEE DeHIHNS, DEPUTY REGIONAL ADMINISTRATOR, REGION IV, U.S. ENVIRONMENTAL PROTECTION AGENCY, ACCOMPANIED BY MIKE McGHEE, CHIEF OF THE WATER QUALITY MANAGEMENT BRANCH IN THE WATER MANAGEMENT DIVISION, REGION IV

Mr. DUCRET. Thank you, Mr. Chairman and members of the subcommittee. Welcome to south Florida. I am the subdistrict chief of the Miami Office and would like to introduce here with me Mr. Aaron Higer, who is the assistant subdistrict chief, a man with approximately 30 years of experience in hydrology of south Florida, and also Mr. Bradley Waller, who is a research hydrologist in the Miami Subdistrict. It is my pleasure, too, to introduce to you a colleague from the U.S. Department of the Interior, Mr. Michael Findley, who is Park Superintendent of the Everglades National Park.

With your permission, Mr. Chairman, I will give a very brief summary of the written testimony that was provided to you, and I will try not to complicate an already very complicated picture of hydrology in south Florida.

Mr. NOWAK. Fine, go right ahead.

Mr. DUCRET. We would like to refer to some graphics. These graphics were generated from a Geological Survey Geographic Information System. These are computer graphics. You have duplicates of these graphics by your packages on the table. I would like to give you an overview of the development of the water management works in the outflow portion of Lake Okeechobee. Keep in mind that your overflight today covered the inflow portion as well; the Kissimmee River, and other drainages on the northern boundaries of Lake Okeechobee.

Beginning in the 1890's, dredging was done in the upper Caloosahatchee River area strictly for navigational purposes, not for water management. In the period 1905 to 1925, major development began under the auspices of the Everglades Drainage District, that was formed to help claim land for agricultural and urban development. During that period the St. Lucie Canal was dug.

The period 1932 to 1938 represents another milestone of development. This phase followed the 1926 and 1928 floods that were ex-

tremely devastating events in that part of the state. All construction that was taking place in the canals that you saw in the previous plate stopped subsequent to those hurricanes. During the period 1932 to 1938, the Hoover Dike was constructed. I believe during your overflight today, you saw over around the south Hoover Dike and east portion of the lake. The dike protects adjacent areas from any lake overflow that might occur during hurricanes. Hurricane-gate structures were installed in the Hoover Dike for regulating water levels within the lake.

During the period 1948 through 1955, the Central and Southern Florida Flood Control District and the Corps of Engineers completed a number of flood control projects. During that period, the most notable project was the north/south levee which was built in response to the 1947 hurricane and the 1948 hurricane. This levee was constructed to protect the urban coastal areas of Dake and Broward Counties.

That particular levee also set the stage for the portion of the basin that would be drained and the portion that would not be drained. And so the future water management in this area was pretty well established by that north/south levee. Some minor canals were also constructed at that time as well as control structures for saltwater intrusion and water-level management.

During the period 1957 through 1962, the water conservation areas were enclosed and most of the central and south Florida Project was completed.

In 1966 through 1968, the south Dade conveyance system was built to protect growing population in south Dade County. This system was in response to a hurricane that occurred in 1960.

That, very briefly, is an overview of the evolution of this water-management system. Water management and the basic hydrology of this system is extremely complex.

The role of the Geological Survey in this area is that we are a factfinding agency of the Government. We have no particular responsibilities in terms of action within the area of water resources. We do not build water works, we do not manage water, we do not regulate water, and we are not actively involved in enforcement of environmental regulations. However, we do fill a role in terms of providing those agencies that are action agencies with data bases that they might use to fulfill their particular charge. Those data bases include water-level information for groundwater, water-discharge information, and water-quality information. All this data and information is collected based on a national standard according to the latest scientific methods. It is unbiased data and it is data that might be used by any of the agencies that have a charge to regulate or to manage. The analyses that we do in terms of investigations are available to all of these agencies also, so they can better fulfill their particular agency responsibilities.

Mr. Chairman, that concludes my brief remarks on this particular basin.

Mr. NOWAK. Thank you very much. We will now turn to Mr. Warren Olds.

Mr. OLDS. Thank you, Mr. Chairman, Committee members. It is certainly a pleasure for me to have an opportunity to appear before

you folks today, particularly to discuss such an important item as the Kissimmee River, Okeechobee and the Everglades ecosystem.

I would like to emphasize that these natural features are ecologically and hydrologically connected or inter-related and thus are fairly called an ecosystem.

I would like to emphasize the Fish and Wildlife Service's primary concerns and interest in the area. As you may be aware, Lake Okeechobee is the second largest natural water body wholly within the jurisdiction of the United States, and for quite sometime it has been well-known for its warm-water fisheries. Also, the southwest portion of Florida has been traditionally a very important overwintering area and breeding area for many migratory birds and this has been so identified in the North American Water Fowl Management Plan. This is a plan jointly entered into between the United States and Canada. Unfortunately, as we have heard from earlier testimony, man's activities in the basins have been going on now for about a century in attempts to manage and regulate waters in the system.

Unfortunately, during this period of time the Service has identified more than 30 species of fish and wildlife which are now listed as either endangered or threatened. These include such notable species as the Florida panther, Everglades kite, southern bald eagle, wood stork, Cape Sable seaside sparrow, American crocodile, and of course there are others.

The Service is also actively involved in the basin in land acquisition and management. We have the Arthur R. Marshall Loxahatchee National Wildlife Refuge, which coincides with Water Conservation Area 3. The Service is also currently working on proposed refuges for the Florida panther which is located in the Big Cypress area and also potential acquisition of the 10,000 Islands area. These areas would involve approximately 45,000 acres of Everglades habitat placed into the Refuge management system.

In addition to the direct management of lands and waters in the basin, the Service is also involved with the action agencies, particularly the Corps of Engineers, under the authority of the Fish and Wildlife Coordination Act and the Endangered Species Act in providing consultation to the other federal agencies relative to the management of fish and wildlife resources.

We also have opportunity on occasion to assist our sister bureaus, the Park Service and the Bureau of Indian Affairs. As you might realize, there are three Indian reservations located in this area, which are administered by the Indians under the auspices of the Bureau of Indian Affairs.

I would like to turn to the concerns of the Fish and Wildlife Service related to the resource management problems in the basin. And I think our number one concern from a fish and wildlife resource standpoint is the rate at which water quality seems to be degradated, and the Chairman and Congressman Shaw very accurately described that deterioration earlier, as it relates to increasing levels of nitrates and phosphates into the water system.

Our studies at Loxahatchee Refuge have indicated that these nutrients are causing some rather substantial changes in the vegetation pattern within the Refuge. The sawgrass wetlands are now being rapidly invaded by rather large stands of cattails, which is

completely changing the vegetation pattern in certain areas of the Refuge.

We are also concerned, as are the state fish and wildlife interests, as it relates to the nitrates and phosphates in Lake Okeechobee. I believe that we are beginning to see an algal bloom again in Lake Okeechobee now as a result of the phosphates and nitrates being at an elevated level. With these high levels of nutrients, we are getting a rather heavy infestation of aquatic vegetation and this leads to an increased aging of the whole system.

I think our second area of concern is the increasing demands on the available supplies of water, particularly for human consumption either through a domestic system or through agricultural utilization.

I understand there is going to be some rather significant expansion of citrus groves in south Florida as a result of some of the more recent freezes that have devastated the citrus industry further north in the state.

The Service also has another significant interest related to the loss of habitat in the basin with the large modifications that have occurred. Particularly the wetland habitats throughout the ecosystem which have been drastically altered and have disappeared. In fact, the most recent modification in the Kissimmee Basin has resulted in the loss of over 40,000 acres of rather significant wetlands. Corresponding to this loss in wetlands, we have also seen a marked decline in the occurrence of migratory birds in the area, particularly waterfowl.

Another concern of the Service would be the current practices of drainage and water management. I think both the Corps of Engineers and the South Florida Water Management District have done an admirable job in their attempts to coordinate and exchange information relative to the water management system. I think there can be a little more close involvement from the Service to offer assistance to these individual agencies.

Another concern that we are also seeing in the basin that is evident, particularly at Loxahatchee, is the invasion of exotic plant species. I do not think that is any new problem here to the folks in south Florida who are familiar with the situation. But three species particularly; malaleuca, the Australian pine and the Brazilian pepper are three exotic plant species which are taking over many areas of the natural systems that have been drained and altered.

And I think the future control of those species, both on public lands and on private land is a challenge for the managers in south Florida.

With those somewhat brief remarks I will conclude my testimony. Thank you, Mr. Chairman.

Mr. NOWAK. Thank you very much, Mr. Olds.

We will go now to the U.S. Army Corps of Engineers, Mr. Steven Dola. Mr. Dola.

Mr. DOLA. Mr. Chairman and members of the subcommittee, like my Federal agency colleagues, I too am pleased to appear before the subcommittee today to present information about the south Florida ecosystem as it relates to the Civil Works Program of the Army Corps of Engineers. With me today are Col. Robert Herndon, commander, and Mr. Mann Davis, chief, Flood Control Branch,

Planning Division, and Mr. Ormond White, Chief, Water Management Section, Engineering Division, all of the Jacksonville District of the Army Corps of Engineers.

With your permission, Mr. Chairman, I would like to have my statement submitted for the record like the others, and I will attempt to summarize.

Mr. NOWAK. Without objection.

Mr. DOLA. I would like to talk a bit about the historical perspective. One cannot fully understand the state of water resources development in south Florida without some perspective of the historical philosophies which led us to where we are today. Early leaders had visions of extensive agricultural development of the lands around the Kissimmee Valley lakes and Lake Okeechobee. Their general plan was to lower water levels to effect that use. We saw that area this morning, and as I pointed out to you, Mr. Chairman, the Everglades agricultural area is rather extensive, it is one-third the size of the central valley irrigated acreage in California. If you take the Salt River irrigation project in Arizona, add to it the Imperial irrigation district and the Coachella Valley irrigation district in southern California, the district here, the Everglades agricultural area, still exceeds all those in size. This is a significant project as we have seen and have come to know.

After the Civil War, moreover, work by Federal, State and private interests resulted in the Okeechobee Waterway, a navigation project that was mentioned by my colleague earlier. We saw the St. Lucie Canal as we flew over the Lake Okeechobee area this morning.

The early philosophy of drainage and reclamation was found to have a dark side, however. First, as south Florida developed, it was learned that the drainage system did not provide adequate protection against floods.

Second, the area was being overdrained and during period of drought suffered from salt water intrusion. Furthermore, land which formerly was regularly flooded was now actually vanishing before the eyes of anxious owners. The peaty organic soils of the Everglades were drying out and shrinking at a clearly visible rate.

This led into the next philosophical phase of water resource development in south Florida, mentioned earlier, that which resulted in the Central and Southern Florida Flood Control Project constructed by the Corps of Engineers with the South Florida Water Management District as local sponsor. The project was for flood control, water conservation, water level control and the prevention of salinity intrusion. Additional purposes included water supply, navigation, fish and wildlife enhancement, recreation and also the preservation of the national park.

I should point out that the Central and Southern Florida Flood Control Project includes a total of a thousand miles of levees, thousand miles of canals, 30 pumping stations, over 200 control structures. Total costs including both capital and O&M costs exceed a third of a billion dollars. It is one of the largest civil works projects in the United States.

In the late 1960's and early 1970's, new concerns were becoming apparent, resulting in yet another philosophical change in the direction of water resource management in Florida. These concerns

focused primarily in the general areas of water quality that have been already mentioned, and loss of wetlands, also mentioned. These concerns found expression in new Corps studies dealing with restoration objectives at existing projects and with water quality and preservation of wetlands.

In the Kissimmee River Basin, for example, a study has been completed which addresses the feasibility of restoring the Kissimmee River between Lake Kissimmee and Lake Okeechobee, which was channelized, as was pointed out, by the Army Corps of Engineers as part of the Central and Southern Florida Flood Control Project. We have a feasibility report completed by the District in September 1985 and it addressed the concerns that channelization was contributing to the eutrophication of Lake Okeechobee as well as other concerns related to the loss of environmental amenities in the river's flood plain. The report recommended no Federal implementation of modifications to the existing project at this time, as the alternatives evaluated would not produce net economic benefits; that is, they were not economically justified, in our common parlance in the water program.

We have talked about Lake Okeechobee and I should mention that the Corps does have in the lake some aquatic plant control responsibilities where priority is given to keeping navigation open. Considering the lake and the Kissimmee River over the last 5 years, the Corps has spent about $6½ million total, some of it at full Federal expense, some of it at 50/50 with the South Florida Water Management District.

In the Everglades National Park, the park has in recent years been adversely affected by water releases; that is, the flows are changed from what they once were from the Central and Southern Florida Flood Control Project. The park officials have requested that flows delivered to the park be redirected by way of the historic northeast Shark River Slough flowway that we flew over. The Corps, in cooperation with the Water Management District, is currently testing a delivery approach referred to as the rain driven model and is preparing a report proposing a framework—recognizing changes may be needed over time—for a new delivery schedule and associated structural modifications.

Finally, with regard to the lower east coast area, the urban area that we flew over, we have had a water supply study there and an interim report is being prepared to summarize findings to date. We also have two flood control studies that recognize the extent of urbanization of the drainage basin that has placed increased demands on the Hillsboro Canal for flood control.

Also, in Broward County, we are going to be starting a reconnaissance report also for flood control in that area.

In conclusion, Mr. Chairman and members of the subcommittee, the Army Corps of Engineers is aware of the desires to maintain and even restore the unique natural resources of south Florida. Cooperative efforts currently underway by Federal and State agencies as well as interest groups and concerned individuals have resulted in actions directed toward preservation and restoration of the ecological resources of the Kissimmee River/Lake Okeechobee/Everglades system. Federal participation in such an undertaking should first be based upon a finding that use of Federal resources is justi-

fied by the expected economic and/or environmental returns. Moreover, the limited Federal financial resources available for this effort requires prioritization of Federal agency involvement in the overall effort. It is through continued cooperation among all concerned parties that maximum progress can be achieved.

Thank you, sir.

Mr. NOWAK. Thank you very much.

Let us now turn to our last Federal witness, Mr. Lee DeHihns, the Deputy Regional Administrator of Region IV.

Mr. DEHIHNS. Thank you, Mr. Chairman, members of the Subcommittee. I am happy to be here today from our office in Atlanta, GA. Accompanying me today we have Mr. Mike McGhee, who is the chief of our Water Quality Branch in Atlanta and also Mr. James Kutzman, who is the chief of our Groundwater Protection Branch. If you have questions later that I am unable to address, I am sure these two gentlemen can assist me.

I am very pleased to be here today to describe to the subcommittee EPA's involvement with protection, restoration and management of the surface and groundwater resources of the Kissimmee River-Lake Okeechobee-Everglades ecosystem. EPA is involved, as you know, with administering a number of environmental statutes passed by the Congress, particularly some that we deal with here in south Florida concerned with water management programs such as requirements under the Clean Water Act, the Safe Drinking Water Act, the Superfund statutes and the Resource Conservation and Recovery Act. We also work very closely with the Federal agencies who are represented here today as well as the other panel members to come from the State and county agencies. Most particularly the nonpoint source pollution programs as they relate to Lake Okeechobee, our wetlands protection program, our groundwater protection and public water supply programs, Superfund hazardous waste program and our involvement with a number of National Environmental Policy Act activities are important to us.

Lake Okeechobee-Kissimmee River area has been studied extensively recently with the LOTAC I and II reports, which I am sure you all are familiar with. Those reports have very clearly identified the lake as being both extensively used and of regional significance for flood control, water supply, sport, commercial fishing, wildlife management and navigation. We all know that Lake Okeechobee is naturally highly productive, but it is also receiving excessive amounts of nutrients, especially phosphorus and appears to be losing its ability to assimilate this phosphorus. If this continues, the lake could become hypereutrophic, which could be a major environmental loss for south Florida. It has been estimated by the LOTAC studies that the phosphorus loading to the lake should be reduced at a minimum by 40 percent. And Ms. Bentley, I might note that that 40 percent target for nutrient reduction in Lake Okeechobee is the same target for the Chesapeake Bay in the agreement that was signed last year by the states and EPA.

The Lake Okeechobee study area has also included the Taylor Creek and Nubbin Slough areas which are two of the major sources of phosphorus loading to Lake Okeechobee. Nonpoint source runoff from dairies and beef cattle farms have been identified as the probable sources of this phosphorus. These basins were named by the

Technical Committee for priority implementation of controls since they contribute significant amounts of phosphorus, and because they have identified sources of phosphorus which can be addressed with existing technology and management practices.

We have been cooperating for some time in the Rural Clean Water Program which has resulted in the installation of BMP's to control nonpoint sources from the dairy farms.

We have also, in the south Florida area, in 1979 designated the Biscayne Aquifer as the sole or principal source of drinking water for public water systems and individual wells in designated portions of Broward, Dade, Monroe and Palm Beach Counties here in south Florida. This designation also includes a drainage area which contributes water to the aquifer's recharge zone. That area is also within the boundaries of the South Florida Water Management District. The Sole Source Aquifer designation allows EPA to prohibit federal financial assistance for any project which we determine may contaminate the aquifer so as to create a significant hazard to public health.

Within the State of Florida, local governments have adopted a Biscayne Aquifer Protection Plan, in 1985, to address water management practices in those areas. Particularly Dade, Broward and Palm Beach Counties have also developed local Wellhead Protection Programs to manage waste generating activities and land use proximal to the well fields. Those programs also fall in line with the requirements of the Wellhead Protection Program of the Safe Drinking Water Act of 1986.

Furthermore, another groundwater protection program is the Underground Injection Control Program under the Safe Drinking Water Act. Delegation of authority occurred in 1983 to the Florida Department of Environmental Regulation, where except for one class of wells, the State of Florida has primary enforcement responsibility for controlling the underground injection activities in the State of Florida.

Finally, one of the other programs where EPA spends quite a bit of regulatory effort in conjunction with our colleagues in the Fish and Wildlife Service, Everglades National Park, the Corps of Engineers and state agencies, is our 404 permit program where we review and react to permits proposed to be issued by the U.S. Army Corps of Engineers.

As you stated earlier, Mr. Chairman, the majority of wetland losses in this country and certainly in this area have occurred in the Everglades area where, since the turn of the century, approximately 40 percent of south Florida's freshwater sawgrass marshes, sloughs and wetland prairies have been converted or lost. Historically, conversion of the wetlands through agriculture and urban development have represented some of the largest losses we have seen.

We have, in Region IV, been working closely with a number of agencies in south Florida in terms of instituting an action to prohibit the issuance of three Corps permits in the east Everglades, an action which is currently pending before our Administrator concerning the protection of 432 acres of wetlands in the east Everglades area adjacent to the national park. We also strongly support the proposal by the State of Florida and the Department of Interior

to purchase 75,000 acres of wetlands in the east Everglades northeast Shark River Slough which borders the Everglades National Park.

We are also working closely with the Corps, the South Florida Water Management District and the Park to evaluate the impacts of the modified water delivery plan to the park. Likewise, we are working with all those agencies and Dade County on an advanced identification-special area management plan in the 14-square mile area Bird Drive-Everglades Basin area west of Miami, to continue to identify which areas of wetlands there need and demand protection.

Finally, Mr. Chairman, the other program when we implement quite a bit of work here in south Florida—all over the country for that matter—again in conjunction closely with the State of Florida Department of Environmental Regulation, is the Superfund program. We are currently investigating approximately 440 suspected uncontrolled hazardous waste sites in 17 counties in the Kissimmee River-Lake Okeechobee-Everglades Basin. These sites are evaluated based on their potential to affect public health and the environment.

Currently, we have placed 13 sites in the 17 counties on our National Priorities List and are considering the addition of ten other sites within the next several months. We also work very closely with the Department of Environmental Regulations to regulate hazardous waste generating facilities in the State of Florida through the RCRA permitting program, which has been delegated to the state.

As you can see, Mr. Chairman, the EPA office has a wide range of activities that affect the environment of the State of Florida, and particularly south Florida. We at EPA are committed to protection, enhancement and restoration of the surface and ground water resources of this area.

I will be pleased to answer any questions you or other members of the Committee may have. Thank you.

Mr. NOWAK. Thank you very much.

We had the opportunity to fly over and get familiar with some of the background of this ecosystem and everything you have said as a group seems to verify that the problem is growing. And looking at the particular nutrients that are overloading the ecosystem brings some memories back to me of the Great Lakes, especially Lake Erie, back in the 1960's when we had a nutrient problem there and phosphorus was labeled the cause of the eutrophication that occurred. We invested large sums of money in the building of treatment plants to reduce that. And then to further make sure that phosphorus level does not come back, we banned phosphorus from going into detergents and laundry throughout the whole county, and I think that has been adopted by other counties throughout the Great Lakes system.

We have seen—you know, the cover of Time magazine listed—I do not think this has happened yet here, but Time magazine said that Lake Erie was dead, it would never come back, the algae was too heavy, the damage too great, no matter what was done. Yet in a period of a short 14 years, we have seen a tremendous improvement in the water quality and now it is termed the best water

quality in the Great Lakes. It is ironic that with all of the sensitivity to water that you have in Florida, that we are here looking at this kind of a problem with nutrient loading and the phosphorus that has been identified. Just about everybody that we have heard from clearly looks at the dairy farming north of the lake and the rice farming south of the lake and almost unanimously—and the sugar cane I should say too—and says that, you know, those are non-point sources that are contributing greatly if not the majority of the excessive nutrients.

I am just wondering if we have identified it that far and as we look at the Federal program which I guess now we could characterize as some technical assistance going to the state, turn it over to the State and ask them to start to look at this problem, and what kind of reactions—we will have some state people testify, but what kind of reaction have we assembled here.

Before I ask that general question, have these fish been tested for any kind of—you know, the chemical test for any kind of toxins in the fish?

Mr. OLDS. Sir, to my knowledge the Fish and Wildlife Service has not conducted any work, chemical analysis of fish flesh for toxicans or other contaminants but I am not aware of whether the State agency may or may not have.

Mr. NOWAK. Well we can ask them when they come. But I am just wondering if the identification of the problem has been made, certainly EPA has clearly said that this was the overall source. And I am wondering if the next step almost should not be an investment of some dollars to take an adequate sampling of those fish before you get too far down the road here in just saying that there is a problem. I just had information from the Pigeon River that EPA has been aware of, and there is concern from some Congressmen in that area about the testing of fish that indicated there were some serious problems. I would think that our step here, federally, should be to take a look at that and at least alert the state to it so that they can take some appropriate action.

But let me ask each of you to comment just on that generalization. Are we all in general agreement of the problem that is leading to the degradation and everything that has been expressed?

Mr. Ducret, would you comment on that first?

Mr. DUCRET. Certainly. Mr. Chairman, the Geological Survey has not collected information or data on that particular issue in Lake Okeechobee, but all of the results that I have heard from hearings and from technical sessions indicate that your summary is a good one.

Mr. NOWAK. Mr. Olds, do you have anything?

Mr. OLDS. Mr. Chairman, I wholeheartedly agree with your summary. I think that is a very accurate description and comparison that you have made with the Lake Erie situation some years back. And I do think that some of the programs that EPA mentioned with the State Water Management District is beginning to carry out in terms of best management practices for the activities in the basin need to be wholeheartedly pursued. There may be other approaches similar to those that we are taking around the Great Lakes that may be applicable to management of the system here in

south Florida, to reduce the level of nitrogen and phosphorus being added to the system and then keep it down.

Mr. NOWAK. You know, if you look at other water bodies I think they are discovering the same type of problem in the Chesapeake Bay.

Mr. OLDS. Yes, sir.

Mr. NOWAK. We have that experience up there. We are dealing with a body of water remember that is vastly larger in terms of depth and movement I think than this body of water, and if it can be cleared up there, I would think you have even more direct kind of source here for that loading and you have perhaps even a narrower problem to attack.

Mr. DeHihns, I am just wondering too, you know, we are looking at this and we have not looked at the type of—we have no testimony of the types of fertilizers perhaps that are used. Do you have any information on that?

Mr. DEHIHNS. Mr. Chairman, first of all, with respect to your broad summary, I agree that there is a problem. I think most everyone has recognized what the problem is. For example, the LOTAC studies, the Lake Okeechobee Technical Assistance Committee's, the first one and then the second committee set up to react to some of the recommendations of the first committee, focused on the influx of pollution into Lake Okeechobee and that whole basin, from the Kissimmee River channelization as well as back pumping of water from the Everglades agricultural area, the drainage from the dairy farms, sugar cane farms, in terms of fertilizers applied to the pasture lands in the dairy farms as well as runoff from the dairy farms themselves in terms of the animal waste, which all flush into the lake. And you have a large lake, a fairly shallow lake, with not that much movement in it, that has been affected by the activities of man over time. Mr. Ducret's charts show from 1890, if you looked at all the lines on there, those were all canals, those are not roads, those are canals moving water to and from various places, principally for purposes of irrigation and flood control.

What you are seeing with these committees that have looked at it and taken the time to implement these measures, is essentially taking a large amount of pollution back out of the lake. It is not stuff that is being dumped directly into the lake from a particular point source, but rather canal backwashing from agriculture lands. You drain the farms into the canal and it flows into the lake. Now as you start looking at taking that stuff back out of the lake, then you have got complications. There is a second committee that the Florida Legislature asked to look at that problem which said okay if you divert the water back into Taylor Creek and Nubbin Slough, what happens then? Do you cause other environmental problems later? We have got such a fragile ecosystem here where we manipulated man's activities for almost a century, and now as we try to cope with how to solve those problems, we have difficulties trying to let the activities that man wants to take place in this area continue while trying to solve the problem. We have got some tough choices to make. We cannot continue the pace of development in this area of the country and try to solve yesterday's problems, because you are just going to create more problems.

I think that is what all of us need to focus on, is not only correctng the problems of the past but trying to make sure we do not continue to exacerbate those as mankind's growth in this area continues. Tough choices.

Mr. NOWAK. Well I have other more specific questions that perhaps we can get back to. I will turn now to Arlan Stangeland for any questions he may have, but I think we are going to be looking at this from a longer point of view and I just want to say to you that if we are going to make some headway here, we will have to I am sure get more definitive answers from you on more specific topics as we assimilate all this material and start to go over it. But I want to thank you for your answers.

Mr. Stangeland.

Mr. STANGELAND. It sounds to me like you have two problems. One is excessive drainage to reclaim land for agriculture and urban development, and by so doing you have allowed reduction of the amount of freshwater to charge aquifers and you get intrusion of salt water. That is one problem. And we would be pleased to hear recommendations as to how you reverse that trend for the underground aquifers.

The other problem you have is nutrient loading in the waters of the lake. From my understanding and my knowledge, nutrient loading goes to encouraging aquatic vegetation that depletes oxygen, but the nutrient loading that you have got is not considered a toxic nutrient loading that causes damage to the fish itself. In fact, it probably enhances the growth of the fish up to a point where the oxygen levels are so reduced that the fish cannot live.

Mr. SHAW. You seem to know an awful lot about fishing. [Laughter.]

Mr. STANGELAND. I think you have a problem here that in ways is similar to the Great Lakes, to Erie and to the Chesapeake Bay. But Erie and the Chesapeake Bay had a whole lot of toxic pollutants beyond just the nutrient loading.

Mr. DOLA. Heavy metals.

Mr. STANGELAND. Yes. The nutrients caused the aquatic growth, but the toxins caused whatever fish were there to be dangerous to eat. I think you do not have the worry of the toxins as much—at least I have not heard that, but the nutrient problem is one.

And, I am wondering how long—if you are testing the quality of the water, has the quality of the water been tested and can you tell us what the level of nutrients in the water of Okeechobee and the Kissimmee River was, say, ten years ago, fifteen years ago and what it is today? How much more serious is it progressing and what do we do to stop that increased problem of nutrient pollution to the lake? And how degrading is this to the quality of water for people to use? I understand Lake Okeechobee is a prime source of freshwater for various municipal water systems. How serious is that pollution to the people's drinking water?

That is a long, rambling kind of question that I guess is more of a discussion but I would like to hear just your response to that kind of discussion. I stated that I come from Minnesota and we have a lot of good freshwater lakes and we are very intensely agricultural, and of course I have a provision for a cleanup of one of my lakes because it is overloaded with nutrients and algae growth.

The fishing is great there but the boating and swimming is lousy. We are going to try to clean it up. After we clean it up, we have got to find a way to prevent a meandering river from picking up fertilizers and chemicals that continue to pollute that lake.

Mr. DEHIHNS. Mr. Stangeland, I guess one response to part of what you asked about would be in terms of what do we know about the levels of the nutrients in Lake Okeechobee and the Kissimmee River system and what flows out of the lake areas; we, all of us who have been on these Lake Okeechobee Technical Assistance Committees have a lot of data, very specific data with measurement points and defined locations. Mr. Creel, I am sure, will get into that some when he appears. Perhaps it would be best for the record if someone, since we all participated in it, would submit for the record the Lake Okeechobee Technical Assistance Report, which will give you immense detail about the kinds of questions you asked in terms of what are the levels, how have they changed. I think the principal summary would be that the phosphorus levels have been increasing and that it is clear that the measures that have been suggested and recommended, if they are not put in place, the levels are going to continue to increase. Whereas other nutrients, such as nitrogen, are not considered to be a limiting factor. And you are very correct in saying we are extremely fortunate that we do not have a toxics problem here.

Mr. STANGELAND. There are some very stringent pieces of legislation that have been introduced in the Congress for the protection of groundwater, very stringent. I have been one to want to go somewhat slow—and this is one of the purposes of hearings like this, to find out first of all what is the problem, how serious is the problem and then what is the responsible solution. For as I started to say, I represent an agricultural district and if there is one thing farmers are resistant to it is land use planning, on one hand. On the other hand, we have got to be concerned with the other resources as well and we have got to find a way that we can live together, protecting the water and the ecosystem on one hand, but also allowing for an agricultural economy to thrive and grow.

Has there been a tremendous increase in the amount of livestock in the northern portions of Okeechobee and Kissimmee River area that causes this tremendous increase in the amount of phosphorus and nitrates to come into the system? I see people nodding their heads.

Mr. DOLA. With the project there has been.

Mr. STANGELAND. Over how many years?

Mr. DOLA. Twenty years.

Mr. DEHIHNS. Again, all of that is discussed at great length in these committee reports, the LOTAC I and II reports. They talk about the dairy farms, talk about the alternatives, what if you took all the dairy farms out what would be the cost and ramifications.

One of the things, Congressman, that we do not find is a tremendous problem in this particular area, there is not much exchange of pollution in this instance from the nutrients into the ground water. The ground water is not that much contaminated and also the nature of it, Mr. Kutzman can talk more about the techniques of it but nutrients are not that much a limiting problem when it

comes to ground water and uses of ground water. Toxics obviously are.

Mr. DOLA. The South Florida Water Management District has 200 plus or minus water quality monitoring stations and I understand also that the Corps has some at key outflow locations from Lake Okeechobee. So presumably that data can be made available.

Mr. STANGELAND. It would be helpful I think for the Subcommittee in the future and for our reference library, in examining the whole problem if we could be provided some of that information and some of the suggested solutions as to how to prevent further degradation.

What is the incidence of cattails and how serious is it? How has it progressed? What can we expect—what do we project say 5, 10, 15 years from now if it is allowed to continue? Maybe some of the state people are going to give us that, but that would be helpful for us to know, just really how serious is the situation, how rapidly is it progressing and what are some of the measures that can be taken to prevent it from increasing. I can surely appreciate the situation for—I have fished in Okeechobee. It is a large body of water but a very shallow body of water and, as the chairman says, not like the deep Chesapeake or the deep lakes in the Great Lakes system. It is a very delicate system.

I have no more questions.

Mr. NOWAK. Thank you. Let me just—the Technical Committee concluded, did they not, that the lake, the phosphorus load should be reduced at least 40 percent? Was that not the basic conclusion of all the technical people who have looked at this?

Mr. DEHIHNS. Yes.

Mr. NOWAK. The answer is yes, is that right? And if we say yes, the next question is then after we conclude that, how do we accomplish it?

Mr. DEHIHNS. Again, there has been a series of recommendations, some of which are still under study in the Lake Okeechobee technical assistance reports, again it's LOTAC I and II that I have continually referred to. Mr. Creel is the principal deliverer on those reports and the manager to implement the recommendations. So I am speaking somewhat out of turn for him, but the 40 percent goal is definitely recognized, has been recognized for some time, it is recognized in Chesapeake Bay as well.

A number of things, best management practices for the farms, divert a lot of the water that has been going into Lake Okeechobee, backwashed into it, flowing into it—take that water elsewhere. I see problems with that. As you divert water from ecosystem to another, you have to be sure you are not adding the nutrient problem to some other ecosystem. The same thing as we have seen the water not being back-pumped from the lake into the Everglades agricultural area, we now have the water conservation areas which is sort of downstream, if you will, those——

Mr. STANGELAND. May I interrupt you for just a moment there?

Mr. DEHIHNS. Sure.

Mr. STANGELAND. In the Clean Water Act, we require pretreatment in freshwater treatment systems for industrial waste. In pumping back the agricultural water, is it feasible for a pretreat-

ment program to treat that water before it comes back into the system?

Mr. DEHIHNS. I think chemical treatment has been examined as one solution. I think it was decided that it would be too costly, so instead you just do not back pump at all. You send the water elsewhere. But as we have seen, that water has now gone from the agricultural area into the water conservation areas, which are essentially Everglades like areas. They are now seeing problems the nutrients are causing there and the worry is it will spread to the national park. So you have to find some way to reduce the nutrients in the water no matter where you send the water.

Mr. NOWAK. Mr. Shaw.

Mr. SHAW. What happens to the—I would like to follow up on the answer to Mr. Stangeland a second ago. What happens to the lake if you start diverting the water that once went into the lake?

Mr. DEHIHNS. Again, encroaching on Mr. Creel's area, but the reports talk about wanting to maintain a certain mean sea level volume of water in the lake, so you have to find some way of making sure that the water that does go back into the lake stays in the lake to keep it at the level you want it to, is as clean as you can make it.

Mr. SHAW. Now we saw where the different canals were all running. Before those canals were put in there, the lake really did not have any boundaries I guess and it just overflowed and sort of was the deepest part of the Everglades. But having said that, then you have to understand in looking at that whole system of the Kissimmee River south to Lake Okeechobee and the Everglades, that it is a giant river, a giant flowing river, and if you start taking that water and putting it elsewhere, you are really messing with the environment at that particular point, which leads me to ask is that solution worse than the problem?

Mr. DUCRET. One thing you might consider, Mr. Shaw, is that a very large portion of that water comes from rainfall. We have some 65 inches of rainfall in this area per year and some of that comes all at once, depending on how tropical storms or hurricanes might develop. And a great deal of freshwater is added to that system outside of the managed water, through rainfall.

Mr. SHAW. I noted during your testimony you made reference to the increasing number of dikes, I believe it was at Morehaven, that was about wiped out during one of those floods. It was a very serious thing.

Mr. DUCRET. Yes.

Mr. SHAW. In Morehaven, which is one of the cities on the western side of the lake, before those dikes were put in, during a hurricane most of the people died from drowning.

Let me get right to the point. Have the nutrients built up in the lake to the extent that it is going to be difficult to get them out, or are they dissolved within the water, so that they readily flow out of the lake?

Mr. DEHIHNS. Again, from—Mr. Creel is probably best to do this, but from our study and participation—well again, he is the Manager of the South Florida Water Management District.

Mr. SHAW. Maybe we ought to speed this up and get to Mr. Creel. [Laughter.]

I want to ask a question and this has been stated as sort of a shock statement in this area forever. First of all I want to know, what is your opinion of what will happen if we do nothing, and allow the present system to continue?

Mr. DEHIHNS. It is pretty clear from our opinion that the lake will become eutrophied.

Mr. SHAW. Now is that nutrified—does that mean that Lake Okeechobee is dying?

Mr. DEHIHNS. Eutrophied, yes.

Mr. SHAW. So if we do nothing, Lake Okeechobee will die, that is what your testimony is.

Mr. DEHIHNS. Yes, sir, eventually.

Mr. SHAW. What is eventually?

Mr. DEHIHNS. I do not know what the predictions are.

Mr. SHAW. Give us your prediction.

Mr. DEHIHNS. Sir, I do not have a number.

Mr. SHAW. Well are we talking about something in the foreseeable future? Let me ask you this, is this a problem that we can——

Mr. DEHIHNS. The next decade or two.

Mr. SHAW. The next decade or two. So it is not a problem that we can sit around and wait for some technological advances to come along and produce a miracle for us so that we no longer have the problem. We have to face the problem and we have to solve it now.

Mr. DEHIHNS. Yes, sir.

Mr. SHAW. And there is no way that we can continue the present course of allowing the runoff from the agricultural uses surrounding the lake to continue?

Mr. DEHIHNS. If it contains high nutrient loads, it cannot continue.

Mr. SHAW. Thank you. Thank you, Mr. Chairman.

Mr. NOWAK. Ms. Bentley.

Mrs. BENTLEY. Thank you, Mr. Chairman.

Mr. Ducret, I notice that you have been in the—served in the waterways experiment station at Vicksburg.

Mr. DUCRET. That is correct.

Mrs. BENTLEY. Do they have the model for this Lake Okeechobee and Kissimmee River down there to test and experiment on?

Mr. DUCRET. I cannot address that. I served at the waterways experiment station 22 years ago. Perhaps some Corps representatives here might.

Mr. OLDS. Would you like to answer that?

Colonel HERNDON. Col. Bob Herndon, District Engineer, Jacksonville. No, there is no model of the Kissimmee or the Okeechobee at the waterways experiment station.

Mrs. BENTLEY. Well that might be something to look at.

Mr. SHAW. There is a bill pending that Tom Lewis and I have worked on that would produce a model for this whole area.

Mr. CREEL. I am Mr. Creel, and I would like——

Mrs. BENTLEY. Oh, you are Mr. Creel. I thought I saw you just go out the door. [Laughter.]

Mr. CREEL. I was the Director at WES before I took this job, waterways experiment station. One of the things that we were doing was an environmental study. Colonel Herndon is correct, there is

no model. We do have a model at the University of California at Berkeley right now.

Mrs. BENTLEY. So you have something to study with.

Mr. CREEL. Yes, and I will be glad to discuss it during my testimony.

Mrs. BENTLEY. Mr. Olds, you mentioned rock mining and rock plowing as additional activities which are irreversibly converting wetlands. What kind of rock mining and rock plowing is going on?

Mr. OLDS. In the eastern Everglades area, the limestone is right at the surface and in order to conduct agricultural operations you need to deep plow that lime rock in order to cultivate for agriculture, or you could also mine it as a construction material resource. But in order to do that, you have to remove the surface water and keep it drained or pumped. Therefore you have eliminated the fish and wildlife habitat which is on the surface. Rather large areas have undergone these conversions and as Mr. DeHihns pointed out earlier in his testimony, we are considering about three areas which are now up for permits under Section 404. We are looking at those very closely with the possibility of not permitting those activities. At least that has been the recommendation of the Fish and Wildlife Service that those activities not be permitted.

Mrs. BENTLEY. While we are on the mining subject, if my memory serves me correctly, there is an area in Florida that has a lot of phosphorus rock. Does any of that fall in the—is there runoff at all that could come into Lake Okeechobee?

Mr. OLDS. To the best of my knowledge, the phosphate mining industry in Florida is located in the center and northern part of the state and that activity, to the best of my knowledge, does influence the Kissimmee Basin, Okeechobee or the Everglades. Potential impacts from that industry go out through I guess the Peace River and out into potentially Tampa Bay and some of the center parts of the state.

Mr. SHAW. Of course phosphates include fertilizers that are used.

Mrs. BENTLEY. Yeah. And so you have the non-point pollution.

You mentioned about the growing number of cattle in the north developing. Is there any effort made in connection with the Agricultural Soil Conservation Service, like I happened to see up in Maryland in the past week, in containing the manure instead of just letting it lie there and run into the streams and everything, to contain it, control it.

Mr. DEHIHNS. Very much so. That is what the Committee recommendation has been, to work with the farmers and through the Soil Conservation Service. Like you, I just visited some areas where pig farmers or hog farmers are doing the same kind of thing, collecting their manure and keeping it out of another estuary we are looking at. Yes, there are a lot of things that can be done and the Department of Agriculture is very much involved in this area of the country as well.

Mrs. BENTLEY. I mean I am impressed with the group of Federal representatives here, but I notice there is no one from Agriculture, and I was just wondering about the relationship that you might have with the Soil Conservation Service.

Mr. DEHIHNS. From our agency's standpoint, we have an excellent relationship. We are working with them—we work with eight

States in the southeast and we literally have hundreds of things we are doing with them all over the southeast. As I said, I was in the field last week in North Carolina with several members of the Soil Conservation Service, Federal employees like myself, looking at hands-on, face-to-face work with farmers to control runoff, nutrients, pesticides, and protect the ground water in that large agricultural area.

Mrs. BENTLEY. I do want to say, Mr. Chairman, I think the panel has presented us with some very valuable information, all well done. And I want to thank you for your presentations.

Mr. SHAW. Mr. Chairman, could I ask one more question?

Mr. NOWAK. Yes, sir. Mr. Shaw.

Mr. SHAW. Whoever is best suited to answer this, if you would. What Federal teeth are there in the law that would require the State and local government to cooperate in the cleanup of Lake Okeechobee?

Mr. DEHIHNS. Sir, the section 319 of the Clean Water Act Amendments of 1987 require all States in the country to submit to EPA within 18 months after passage of the law, a nonpoint source assessment of the nonpoint source problem in their States and then to provide a management plan as to how they are going to assess those problems. That has to be submitted to EPA for approval. If the States do not adopt those plans, then EPA is required, after some other work, to move in and try to implement a plan. Obviously we do not have any plans from any of the States yet under that provision, so it is hard to tell how this is going to go. But from our work with the Florida Department of Environmental Regulations and all the Water Management Districts in the State of Florida, we feel comfortable they will do that work here in the State of Florida.

In terms of teeth, there is no funding restrictions or withdrawal, there are no sanctions necessarily that are punitive in nature for not doing that work.

In terms of point source discharges into the lake or Kissimmee River, again we administer the NPDFS permit program in the State of Florida, so we have all the teeth we need right there in terms of point source discharges, controlling them. We also have sanctions we can bring against municipalities who primarily discharge nutrients into this system, and we are in fact—have some actions going against some communities in the area in Federal court to get them to comply with the requirements of the Clean Water Act.

So from our perspective and the State of Florida's perspective, there are a lot of teeth, but nonpoint source implementation plans are principally State and local efforts. You have got to get the local and State leaders behind those, get the agriculture community and the business leaders behind that and do that as part of some sort of idea on how you are going to have growth in a particular area. That is very crucial in this area of Florida, no doubt about it.

Mr. SHAW. Thank you.

Mr. NOWAK. Thank you very much. I thank each of you individually for the time you put in to bring this testimony here.

[The prepared statements of Mr. Ducret, Mr. Olds, Mr. Dola, and Mr. DeHihns follow:]

Testimony of G. Louis Ducret, Jr., Chief, Miami Subdistrict Office, Water Resources Division, U.S. Department of the Interior, Geological Survey

AUTOBIOGRAPHY

I am G. Louis Ducret, Jr., Chief of the Miami Subdistrict Office of the U.S. Geological Survey, Water Resources Division, in Miami, Florida. I have been chief of the office since 1982 and came here with a background in surface-water hydrologic analyses acquired in Portland, Oregon; Denver, Colorado; and Little Rock, Arkansas. I have been with the Division since 1962, with 2 years out to serve in the U.S. Army at the Waterways Experiment Station in Vicksburg, Mississippi.

MIAMI SUBDISTRICT OFFICE

The Miami Subdistrict is active in water-resources investigations and data collection in the south Florida penninsula; generally within the outflow areas of Lake Okeechobee and the Florida Keys. This work is accomplished with a current staff of 54 scientists, engineers, and support people and a 1988 fiscal year total operating budget of approximately 3.1 million dollars. State and local governmental agencies provide 1.5 million dollars of these funds through a Federal/cooperative matching program. There are 8 science-based, problem-oriented water-resources investigations, 73 surface-water gaging stations, approximately 1,000 observation wells to monitor ground-water levels, and 52 water-quality stations operated within the framework of this program. The Miami Subdistrict (as with all division field offices) is charged with addressing water problems by applying latest scientific methods and collecting, analyzing, and publishing water data using established, national standards.

LAKE OKEECHOBEE OUTFLOW WATER-MANAGEMENT ISSUES

Under natural conditions that prevailed before the late 19th century, the region that now comprises the Kissimmee River, Lake Okeechobee, and the Everglades was a single drainage system. This 9,000 square-mile area is about 200 miles in length from the headwaters near Orlando southward to the Gulf of Mexico. The average width is about 45 miles. The elongated shape of this drainage area and the normally erratic rainfall distribution indicate that the duration and magnitude of water flow, at a given time, varied from place to place in the basin. It is probable that within the extensive area, events of flood and drought occurred concurrently. At some locations in the drainage basin, complete cessation of overland flow probably occurred and persisted for either brief or extended periods, while in other places, moderate to heavy flows occurred. In general, however, the flow was southward from the upper end of Kissimmee drainage area to the coastal marshes at the southern tip of Florida. The Everglades National Park is at the lower end of this drainage area.

The hydrologic regimen of the Lake Okeechobee-Everglades area has undergone continuous modifications since settlement began late in the nineteenth century. Before drainage and land reclamation in the northern part of The Everglades, water levels in Lake Okeechobee and those in the Everglades adjacent to the lake were about the same during periods of high water; limited overflow occurred when water stages reached 15 feet, and outflow along the south shore became general at a stage of about 18 feet. Most of the land in southeastern Florda, presently utilized for urban, suburban, and agricultural purposes, was inundated all or much of the time under natural predevelopmental conditions.

Modification of overland flow in The Everglades began when drainage canals and levees were built around Lake Okeechobee beginning in 1881. Early settlement was on the higher ground, where flooding during the rainy season was less probable. Major urban expansion in the early 1900's occurred in the vicinity of Miami, Fort Lauderdale, and West Palm Beach. Drainage canals were extended inland along natural drainageways. Urban areas expanded westward on land formerly inundated or used for agriculture, displacing agriculture to land farther inland towards the east edge of the Everglades. Most of the excavation for major drainage canals along the lower east coast was completed by 1932, but discharge from the canals was either uncontrolled or inadequately controlled. As a consequence, continuous drainage resulted in lowered ground-water levels and seawater intrusion into the Biscayne aquifer in the Miami area. After the 1943–45 drought, major canals through the coastal ridge were equipped with control structures, which prevented overdrainage during dry periods and prevented additional or reduced existent seawater intrusion.

Extensive flooding which followed the heavy rains of 1947 led to the establishment in 1949 of the Central and Southern Florida Flood Control District, whose

functions were to furnish flood protection to urban and agricultural lands during rainy seasons and to provide facilities for conserving water for allevation of the effects of drought. Work on new water-control facilities, in collaboration with the U.S. Army Corps of Engineers, proceeded during the 1950's; Water Conservation Areas 1 and 2 were enclosed by levees in Palm Beach and Broward Counties, and a large area southeast of Lake Okeechobee was made usable for agriculture by the system of levees, canals, and pumping stations. By the end of 1962, Water Conservation Area 3 was enclosed on the south side, and for the first time, surface flow in the Everglades north of the Everglades National Park could be fully controlled. Conservation Area 3 was considered fully enclosed by July 1967 except for a 7.1 mile stretch of levee between L–28 interceptor levee and the L–28 tieback levee on the west side. The Kissimmee River Waterway Project shortened the river by 40 miles, from 90 to 50 miles in length, and construction was finished in 1972.

The prime effect of the water-control works in south Florida has been to facilitate the flow of water out of the Everglades by means of the canal system, thereby changing the spatial and temporal distribution of runoff. Since 1953, the freshwater flow that otherwise would have been discharged to the ocean in southeastern Florida has been reduced by 80 percent as a result of flood and water-control measures.

Before drainage, water levels were near or at land surface along much of the coastal ridge area. One principal effect of pre-1945 land-reclamation practices was the lowering of ground-water levels through the coastal ridge and interior areas. Overdrainage of many coastal areas allowed seawater intrusion of canals and the Biscayne aquifer, the source of nearly all potable water in the area.

Hydrologic information from the early 1930's indicates that pristine conditions in Dade County, Florida, were marked by high ground-water levels near the coast and in the Everglades, freshwater springs welling up through the floor of Biscayne Bay, and 50-foot deep flowing wells yielding potable water near the mouth of the Miami River. Conditions began to change with the dredging of the Miami River and the inland extension of the Miami Canal which was cut into permeable zones of the underlying limestone of the Biscayne acquifer. Drainage by the canal lowered ground-water levels in adjacent areas, disturbed the natural balance between the fresh ground water and the saltwater of Biscayne Bay, and permitted saltwater to locally intrude the limestone. In addition to the Miami Canal, several other canals were dug which also contributed to lowered water levels, causing saltwater intrusion to advance along a broad front in coastal Dade County. Intrusion remains a major problem facing local and regional water-management agencies.

The investigation of saltwater intrusion in Dade County by the Geological Survey began in the late 1930's and continues in cooperation with Dade County, the Miami-Dade Water and Sewer Authority, the South Florida Water Management District, the Florida Keys Aqueduct Authority, and Homestead Air Force Base. It is through this continuing long-term study of the extent and causes of saltwater movement that assessments can be made of methods and criteria for controlling saltwater intrusion in the highly permeable Biscayne aquifer in Dade County—the sole source of drinking water for the area.

Saltwater intrusion is particularly prevalent in coastal Dade County because of the high permeability of the limestone composing the Biscayne aquifer, because of the interconnection between canals and the aquifer, and because of the seasonal and year-to-year variability of rainfall. The problem is accentuated because urban growth continues to encroach on inland wetland areas, the drainage of which results in lowered inland water levels. In turn, this lowering of water levels increases the probability of saltwater intrusion at the coast. In addition, Dade County is at the south end of the South Florida Water Management District where water levels are influenced by upgradient water-management practices. Also, Dade County is one of the counties farthest south of Lake Okeechobee—the source of much of the water replenishment by canals to the east coast areas during dry seasons.

The overdrainage has been arrested and, since 1954, with completion of the levee systems east of the three conservation areas, water levels have tended to stabilize in most of Dade County. Yearly peak water levels are considerably lower than in pre-flood control times, and yearly low water levels are higher than in pre-management times. For example, during 1945, after a prolonged drought, salty water moved up the Miami Canal and intruded the Biscayne auqifer in the vicinity of the Miami well field, when water was being withdrawn at 30 million gallons per day. In 1966, in a similar dry season, water was being withdrawn at 80 million gallons per day; minimum water levels near the center of the field were about the same as in 1945, but seawater intrusion was controlled. The improved conditions of well-field production and salinity control are results of salinity barriers in canals and replenishment

of water in well-field areas from canals. Similar conditions prevail at other near-shore well fields in the southeast Florida area.

Chemical quality of the surface waters and bottom materials in the Everglades of Everglades National Park has been of some concern since completion of the levee systems east of three water-conservation areas. The Geological Survey collected surface-water and bottom material samples in Everglades National Park from 1959 to 1977 and analyzed them for major chemical and physical parameters, macronutrients, and trace elements. From the mid-1960's through 1977, analyses were performed for pesticides.

There are three major drainageways in the park: Big Cypress Swamp, Shark River Slough and Taylor Slough. The park receives its water from three principal sources: (1) uncontrolled sheet flow from the Big Cypress Swamp, (2) regulated flow from Water Conservation Area 3A and underflow from 3B, and (3) rainfall. Before 1963, all surface-water flow into the park was uncontrolled.

Seasonal changes in water levels caused marked changes in surface-water quality. Evaporation and transpiration of water by plants, intense biological activity, and major physical-chemical reactions cause increasing concentrations of chemical constituents and changes of color during the dry season.

Long-term changes in the concentrations of sodium, magnesium, potassium, chloride, dissolved solids, and iron and color levels have occurred in the Shark River Slough. No long-term changes in water quality have occurred in either the Big Cypress Swamp or Taylor Slough drainageways. Water-quality changes can be attributed primarily to the channelization of more mineralized water down the Levee 67A Canal directly to Shark River Slough and the implementation of water-management practices since 1963.

Macronutrient concentrations increase greatly during low water. Nitrogen species are dominated by organic nitrogen. Phosphorus and carbon concentrations are dominated by either organic or inorganic forms depending on water levels and soil type at the particular sampling station.

Trace-element concentrations, except for iron, do no exceed U.S. Environmental Protection Agency criteria for drinking water during periods of high water. As water levels recede during the dry season, trace-element concentration fluctuate in the ponds. The greatest increases in concentration were noted for iron, manganese, aluminum, and zinc.

Pesticides were detected in less than 2 percent of all surface-water samples collected within and adjacent to Everglades National Park. In contrast, nearly 80 percent of all bottom material samples analyzed contained detectable pesticide residues. Most of the residues were chlorinated-hydrocarbon insecticides. Their distribution in the park is widespread and is caused primarily by atmospheric transport.

This concludes my technical description of the Kissimmee River/Lake Okeechobee/Everglades hydrologic system, and I will be glad to answer any questions you may have.

STATEMENT OF MR. WARREN T. OLDS, JR., ASSISTANT REGIONAL DIRECTOR FOR FISH AND WILDLIFE ENHANCEMENT, SOUTHEAST REGION, U.S. FISH AND WILDLIFE SERVICE, DEPARTMENT OF THE INTERIOR

Mr. Chairman, I appreciate the opportunity to appear before you today to discuss environmental issues associated with the Kissimmee River/Lake Okeechobee/Everglades Ecosystem.

I am Warren T. Olds, Jr., Assistant Regional Director for Fish and Wildlife Enhancement, Southeast Region, U.S Fish and Wildlife Service (service). The Fish and Wildlife Enhancement Division is responsible for providing technical assistance to private and public agencies regarding the sound management of the Nation's fish and wildlife resources.

You requested that we address significant environmental issues affecting the Kissimmee River, Lake Okeechobee, and the Everglades. I would like to stress, at the outset, that these natural features are ecologically and hydrologically interrelated and are appropriately referred to as an "ecosystem."

HISTORICAL BACKGROUND

For perspective, I will provide a brief historical background on the Everglades Ecosystem. In terms of geologic history, the Everglades developed as a shallow marshy river, after the last period of submergence by the sea. This marshy 40-mile-wide river flowed slowly for the 170 miles from Lake Okeechobee to Florida Bay, dropping only 20 feet over that distance.

Before man's influence, the Everglades received seasonal pulses of fresh water in the form of surface sheetflow. At times, Lake Okeechobee filled and spilled water into this enormous basin. Beginning in the early 1900's, the patterns of surface water abundance and distribution began to change. The Caloosahatchee Canal was completed in 1882. Between 1905 and 1913, both the north New River and Miami Canals were in operation. By 1921, the Hillsboro and West Palm Beach Canals were beginning to drain the basin. At the same time, the St. Lucie Canal was dug to provide drainage form Lake Okeechobee.

In 1928, a devastating hurricane stimulated Federal involvement in flood protection which resulted in construction of the Herbert Hoover Dike around Okeechobee in the early 1930's. The early droughts of the 1940's, however, highlighted the potential for salt water intrusion problems associated with overdrainage, and the hurricane of 1947 pointed out the inability of the water management system to handle flood waters.

To reverse these problems, in 1949 the Florida Legislature created the Central and Southern Florida Flood Control Project. Companion Federal authorities were also enacted. Major efforts in the Everglades Ecosystem in the 1960's involved the creation of the water conservation areas, whcih prevented overdrainage of the remaining Everglades by segmenting and impounding them. Finally, in 1963 work began on channelization of 98 miles of the Kissimmee River into 56 miles of canal, which was completed in 1971.

Today, the Kissimmee/Okeechobee/Everglades Basin is part of one of the largest, complex water management systems ever created.

FISH AND WILDLIFE RESOURCES

I would next like to discuss the status of the fish and wildlife resources associated with the Everglades Basin and the role of the Fish and Wildlife Service in managing those resources.

The Everglades Basin includes Lake Okeechobee, the second largest natural water body contained wholly within the United States. This nearly one-half million acre lake is considered one of the premiere warmwater fisheries in the country, and is often featured on national hunting and fishing progams. Southwest Florida is also an important over-wintering area for migratory birds as identified in the North American waterfowl management plan.

The Everglades Basin provides habitat for as many as 30 federally threatened and endangered species, including such notable species as the Florida panther, Everglade kite, bald eagle, wood stork, Cape Sable sparrow, manatee, and American crocodile. The marshes and wetlands contain extensive emergent and submerged aquatic vegetaton that provide for flood storage, filter nutrients and pollutants, and serve as the home for a variety of fish, reptiles, birds, and mammals.

The Fish and Wildlife Service is closely involved in the management of this ecosystem. Federally managed lands within the basin include the Arthur R. Marshall Loxahatchee National Wildlife Refuge, the proposed Florida panther and Ten Thousands Islands National Wildlife Refuges, the Everglades National Park, Big Cypress National Preserve, and Biscayne Bay National Monument. We are also involved with providing technical assistance for management of other lands including Big Cypress, Brighton, and Miccosukee Indian Reservations.

Currently, the Service is involved in a land acquisition/exchange program involving the acquisition of 45,000 acres of Everglades habitat to create two new national wildlife refuges—Ten Thousand Islands Refuge, located along the southwest coast of the Everglades, and the Florida Panther Refuge, located in the Big Cypress Swamp. In addition, the National Park Service is negotiating to add 83,000 acres to the Big Cypress National Preserve. The Florida Department of Natural Resources is also acquiring land in the East Everglades, Kissimmee River flood plain, the Big Cypress region and other areas of the Everglades. These land acquisition efforts are necessary to maintain the long-term integrity of the Everglades Basin.

The Service is also involved in the management of the Everglades Basin through the Corps of Engineers regulatory and civil works programs, in accordance with our advisory role pursuant to the Fish and Wildlife Coordination Act. In addition, the Fish and Wildlife Service consults with Federal agencies under section 7 of the Endangered Species Act to protect federally listed species and their critical habitats, and provides Federal funding to the State of Florida under section 6 of the Endangered Species Act for research and management purposes. The continued survival of many of these threatened and endangered species is directly related to the wise management of the Everglades Basin.

Finally, the Fish and Wildlife Service's Research and law enforcement personnel provide additional resource information and protection for the Everglades Basin.

RESOURCE CONCERNS

Mr. Chairman, I would like to discuss the resource concerns which are adversely affecting the Everglades Basin.

Water quality degradation of the Everglades Basin is a primary concern of the Service. When Everglades muck soils are drained, they not only subside but also release nitrogen into the water. The vast 700,000-acre Everglades agricultural area is releasing nitrates, in addition to phosphates from fertilizers, into the drainage system of the basin. Recent studies in the Everglades National Park reveal that even low level nutrient-rich waters from the agricultural and dairy industries adversely affect the base of the food chain.

Studies of our Arthur R. Marshall Loxahatchee National Wildlife Refuge demonstrate that major habitat changes are occurring as a result of nutrient-rich water entering the refuge. Historic Everglades Sawgrass Wetlands are being invaded by large stands of cattails. Thus, as the uptake of nutrient-rich water continues, vegetative species composition is altered and this "living filter" becomes saturated and loses its ability to absorb additional nutrients.

With respect to Lake Okeechobee, the rapid growth of the agricultural and dairy cattle industries—in large part a result of the construction of the Herbert Hoover Dike around the lake in the 1930's—has introduced large amounts of phosphates and nitrates into the waterways feeding the lake. The concentration of cattle on land around the lake and the channelization of the Kissimmee River, combined with the back-pumping of excess waters from agricultural lands to the south, has resulted in nutrient loading to Lake Okeechobee. This, in turn, has culminated in aquatic vegetation infestation and algae blooms, and could lead to eventual eutrophication.

Increasing demands for water in urbanized areas also contributes to the complexity of this water management system. Waters that would otherwise be available for dilution of heavy nutrient concentrations are diverted for other uses. Large wellfields now pump millions of gallons of water a day to populated areas, thereby altering surface water patterns and drying up Everglades habitat. In addition, the expected irrigation of over 400 square miles of new citrus groves in Collier, Lee, Glades and Hendry Counties will add to the demand for this resource. The conversion of land in the Big Cypress Watershed raises concerns about the long-term protection of the water resources, wetlands, and fish and wildlife of this region.

The Service's second primary resource concern in the Everglades Basin is the loss of habitat. For example, when the Kissimmee River was channelized, an estimated 40,000 acres of wetlands were lost. The creation of the Everglades agricultural area and urbanization at the edges of the basin are resulting in continued habitat loss. Rock-mining and rock-plowing are additional activities which are irreversibly converting wetlands.

All of the factors have been engendered by the tremendous population growth in south Florida. The continual loss of habitat in the remaining Everglades Basin has resulted in cumulative impacts to fish and wildlife resources.

Our third concern is drainage and water management practices within the basin. The Everglades have now been drained to the extent that water levels are much lower than they were in historic times. Also, the man-made system functions to get rid of waters through a variety of impoundments and canals in order to keep peripheral agricultural and urbanized areas dry, while the remaining impounded areas rise and fall rapidly. These extreme fluctuations are a cause for great stress on the fish and wildlife resources inhabiting the Everglades.

Everglades National Park is at the end of this "pipeline" and is dependent on what water is left over. Consequently, there may be too little or too much, and it may arrive at inappropriate times.

Our final concern involves the introduction and proliferation of exotic plant species in the Everglades Basin. Certain exotic species have invaded large parts of the Everglades, mostly in areas disturbed by drainage. The major invaders are melaleuca, Australian pine, and Brazilian pepper.

Melalecua often grows in very dense stands and replaces native vegetation. It has little known wildlife value. The south Florida climate is ideal for melaleuca, much like the plant's native Australian range. The seeds do not germinate where the soil is too wet or too dry, but once established, melaleuca can thrive in areas that are completely dry or constantly flooded. Disturbances and fire, particularly hot fires that occur after drainage, provide ideal conditions for the expansion of melaleuca forest into former Everglades wetlands.

Mr. Chairman, this concludes my prepared statement. I will be pleased to answer any questions you may have.

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STATEMENT OF STEVEN DOLA, DEPUTY FOR MANAGEMENT AND BUDGET

Mr. Chairman and Members of the subcommittee:

INTRODUCTION

I am pleased to appear before your subcommittee today to present information about the south Florida ecosystem as it relates to the Civil Works Program of the Army Corps of Engineers. With me today are Mr. Mann G. Davis, Chief, Flood Control Branch, Planning Division, and Mr. Ormond C. White, Chief, Water Management Section, Engineering Division, of the Jacksonville District of the Army Corps of Engineers. The goal of my statement is to inform the subcommittee concerning the features of the area and the topics mentioned in your letter inviting testimony related to the Army civil works role.

My statement begins with a brief description of the area and the scope of past civil works activities in the area. Then, as one cannot fully understand the state of water resource development in south Florida today without some perspective of the historical philosophies which led us to where we are, the statement provides a short history of the events of the past that influence many of the issues we face today. I will then discuss current issues that the Corps faces, ranging from pre-authorization studies to operation and maintenance of facilities for which we have responsibility. These will be discussed in descending north to south order beginning with the Kissimmee River Basin and proceeding to Lake Okeechobee and then south through the Everglades. My complete statement addresses these topics:

Description of the area,
Civil works investments in south Florida,
Historical perspective, and
Recent Civil Works activities in south Florida

DESCRIPTION OF THE AREA

The south Florida area that is covered by this statement includes the major physiographic features referred to as the Kissimmee River basin, Lake Okeechobee, and the Everglades, and also includes the highly urbanized lower east coast. Rainfall in the area generally averages about 54 inches per year, with about 36 inches falling between May and September. The land surface generally slopes downward from north to south, but at an extremely low gradient. The surface water hydrology includes the extensively managed works of the Central and Southern Florida (C&SF) Flood Control Project. Two major aquifers are of considerable interest in the area, the Floridan, which is artesian, and the Biscayne, which is surficial. The Floridan is potable only in the northern part of the area of concern, while the Biscayne is the main source of water for the urban lower east coast and is designated a "sole source" aquifer by the Environmental Protection Agency. The map on the following page depicts all these areas.

The Kissimmee River system is a major source of surface water flow to Lake Okeechobee and is comprised of the Kissimmee chain of lakes and the Kissimmee River valley. The Kissimmee River between Lake Kissimmee and Lake Okeechobee was channelized by the Corps of Engineers as a part of the C&SF Project, with work being completed in 1971. The system includes an outlet structure from Lake Kissimmee and a series of five (5) water control structures throughout the length of the canal. Controlled connections were made between many of the lakes in the upper basin, resulting in a highly managed water control system in the Kissimmee River basin.

Lake Okeechobee is the second largest natural freshwater lake in the coterminous United States, covering an area of approximately 730 square miles, and is a major feature of the Everglades ecosystem. The lake is also the primary storage reservoir of the C&SF Project. The lake receives water primarily from rainfall and surface inflows from the Kissimmee River, Taylor Creek, and Fisheating Creek basins. Because of the large surface area, much of the water is lost to evaporation. The Caloosahatchee River and St. Lucie Canals are the primary outlets for the release of floodwater, while water supply releases are made mostly through the four agricultural canals: the West Palm Beach Canal, the Hillsboro Canal, the North New River Canal, and the Miami Canal. Water levels in the lake are managed according to a regulation schedule developed by the Corps of Engineers and the South Florida Water Management District (SFWMD). The Corps of Engineers operates and maintains the primary structures and navigation locks around the lake, and is responsible for maintaining the levels within the regulation schedule. SFWMD operates and maintains the secondary water control structures and pump stations.

The Everglades is a vast system of marshes, sloughs, tree islands, and cypress forests that historically covered much of southeast Florida. The northern portion of the original Everglades, now the Everglades Agricultural Area (EAA), covers approximately 1000 square miles and has been developed for agricultural use. Large tracts of the original Everglades (about 1350 square miles) are contained in the three large Water Conservation Areas of the C&SF project. The Everglades National Park (ENP) covers an area of about 2200 square miles at the southern tip of the peninsula. About one third of that area is original Everglades, the rest being more open waters. The Park is managed by the National Park Service as an environmental preserve. Much of the remaining original Everglades is included in the Big Cypress National Preserve, or has been developed for agriculture.

The Lower East Coast covers the Atlantic coastal fringe area extending from the Martin-Palm Beach County line down through lower Dade County. In all this area covers some 1,550 square miles. It is bounded by the Atlantic Ocean on the east and the water conservation areas and the Everglades National Park on the west. The area is characterized by reclaimed Everglades marshland in the west, the coastal ridge, and the coastal marsh and mangrove areas along the Atlantic seaboard. These physiographical characteristics have been greatly overshadowed by the intense urbanization that has taken place in the area. Extensive development has resulted in nearly complete urbanization of the coastal region from West Palm Beach southward through Miami.

CIVIL WORKS INVESTMENTS IN SOUTH FLORIDA

The principal federal water resources development investments that affect the Kissimmee River/Lake Okeechobee/Everglades are the Central and Southern Florida Flood Control Project and the Okeechobee Waterway (formerly Caloosahatchee River and Lake Okeechobee Drainage Areas, FL).

The C&SF Project, originally authorized in 1948 by P.L. 858, 80th Congress, includes a total of 990 miles of levees, 978 miles of canals, 30 pumping stations, 212 control structures, 56 railroad bridge relocations, and 2 highway bridge relocations. Total Federal costs through September 30, 1987, were $300,617,159 for new work and $55,697,504 for maintenance, a total of $356,314,663.

The Okeechobee Waterway is a navigation project that traverses the Florida peninsula via the Caloosahatchee River, Lake Okeechobee, and the St. Lucie Canal. Total Federal costs for this project through September 30, 1987, were $5,178,315 for new work and $25,681,184 for maintenance, a total of $30,859,499. The project was authorized in 1930 by P.L. 520, 71st Congress.

The Lake Okeechobee Aquatic Plant Management Program is funded by the Corps of Engineers under two separate programs: (1) The Removal of Aquatic Growth (RAG) Project, which is 100% Federally funded, is directed toward aquatic plant management in Federal navigable waters; and (2) The Aquatic Plant Control (APC) Program, which is funded 50/50 between the Corps of Engineers and the State (Florida Department of Natural Resources), is directed toward aquatic plants in public waters. Total Federal expenditures under these programs for the period beginning Fiscal Year 1982 and through Fiscal Year 1987 for Lake Okeechobee are $3,101,900, and for the Kissimmee River are $3,498,200. Most aquatic plant management in the Kissimmee River is covered by the RAG Project.

HISTORICAL PERSPECTIVE

The general trend of water resource development in south Florida had been defined before Florida became a state. Leaders of the day had visions of extensive agricultural development of the lands around the Kissimmee valley lakes and Lake Okeechobee. Their general plan was to lower water levels to effect that use.

Prior to February 22, 1819, the territories then known as east and west Florida were held by the Kingdom of Spain. A treaty of that date ceded those properties to the United States. When Florida became a State in 1845, it was with the same vested rights as the original states concerning the sovereignty of navigable rivers and lakes lying within her boundaries. The United States, however, continued as proprietor of all lands which it had acquired from the Spanish Crown and which had not been otherwise dispose, principally the Everglades.

The potential importance of that large body of Federally owned swamp lands known as the Everglades was recognized by the officials of the newly created state, and on the year of its admission into the Union, the Florida Legislature instructed the Senators and Representative from the State to press upon Congress the imprtance of examining and surveying the Everglades with a vew to their reclamation through drainage.

Through the efforts of Florida's elected officials and after giving attention to similar situations in other States, Congress, in 1850, passed what is generally referred to as the "Swamp and Overflowed Lands Grant Act". This Act conveyed the whole of Florida's swamp and overflowed lands to State ownership. An important stipulation in the Act was that the sale of the lands to private interests should finance the necessary work of reclamation.

The reclamation effort remained idle until after the Civil War, when the State Trustees of the Internal Improvement Fund, overseers of the lands conveyed to the State, found themselves in receivership. Attempting to accomplish the drainage and reclamation objective, and to finance the Fund, the Trustees entered into a contract with Mr. Hamilton Disston of Philadelphia. The principal requirement of Disston was to reclaim, drain, and render fit for cultivation, the lands in the Kissimmee valley and around Lake Okeechobee by lowering the water levels of Lake Okeechobee.

Disston's work included connecting the Caloosahatchee River to Lake Okeechobee, connecting several lakes in the Kissimmee valley, and opening navigation from the Gulf of Mexico to the town of Kissimmee. After Disston's death in 1896, the State created what eventually became the Everglades Drainage District to further carry out the drainage and reclamation objective. Some of the major works of this District were the St. Lucie Canal, the West Palm Beach Canal, the Hillsboro Canal, the North New River Canal, and the Miami Canal.

The Federal government first became involved in flood damage prevention in Florida following the disastrous hurricanes of 1926 and 1928, in which about 200 and 2400 individuals, respectively, died around Lake Okeechobee. This work consisted of the construction of major levees and control gates around Lake Okeechobee by the Corps of Engineers.

The early philosophy of drainage and reclamation was found to have a dark side. First, as south Florida developed, it was learned that the drainage system did not provide adequate protection against floods. Second, the area was being over drained, and during periods of drought, suffered from salt water intrusion. Furthermore land which formerly was regularly flooded was now actually vanishing before the eyes of anxious owners. The peaty, organic soils of the Everglades were drying out and shrinking at a clearly visible rate. Thousands of acres caught fire and the muck itself was consumed and lost forever.

This led into the next philosophical phase of water resource development in Florida; that which resulted in the Central and Southern Florida (C&SF) Flood Control Project. This comprehensive plan resulted in a project for flood control, water conservation, water level control, and the prevention of salinity intrusion. Additional purposes included water supply, navigation, fish and wildlife enhancement, recreation, and the preservation of Everglades National Park. This project had it's first authorization in 1948, and has had several additional authorizations since that time. It was a cost shared project and the State created an agency to act as the local sponsor, currently known as the South Florida Water Management District.

In the late 1960's and early 1970's, new concerns were becoming apparent, resulting in yet another philosophical change in the direction of water resource management in Florida. These concerns were many and varied, but were focused primarily in the general areas of water quality and loss of wetlands. These concerns resulted in new studies dealing with restoration objectives at existing projects and construction of new projects that consider water quality and preservation of wetlands as an equal objective with the other project purposes. I will now provide a general overview of the ongoing Corps of Engineers activities within the C&SF area.

RECENT CIVIL WORKS ACTIVITIES IN SOUTH FLORIDA

A study has been completed which addresses the feasibility of restoring the Kissimmee River between Lake Kissimmee and Lake Okeechobee, which was channelized as a part of the C&SF Project. Water quality in Lake Okeechobee and the various estuaries into which the Project discharges have received much attention and study. Aquatic plant control measures have come under increasing scrutiny. Much effort has gone into studies and field tests on restoring a more natural flow of water to the Everglades National Park. All of these initiatives reflect the current concerns and directions of water resource management within the state, which, added to the need to provide a good, reliable, source of high quality water for the highly urbanized lower east coast, result in the broad spectrum of ongoing studies and activities currently underway in the south Florida.

Kissimmee River Basin

The Corps of Engineers has several programs and studies recently completed or underway which affect the Kissimmee-Okeechobee-Everglades ecosystems. A feasibility report on the Kissimmee River was completed by Jacksonville District in September 1985. The report addressed concerns that the channelization of the Kissimmee River was contributing to the eutrophication of Lake Okeechobee as well as other concerns related to the loss of environmental amenities in the river's floodplain. The report recommended no Federal implementation of modifications to the existing project at this time, as the alternatives evaluated would not produce net economic benefits contributing to the nation's economic development. The alternatives evaluated were generally beneficial for environmental concerns, and the report recommended certain options which would enhance the basin's ecosystem.

Section 1135 of the Water Resources Development Act of 1986, Public Law 99-662 provides increased flexibility in the modification of existing Corps projects for environmental enhancement. Demonstration projects that focus on the areas of the Kissimmee River known as Pool "C" and Paradise Run have been developed. However, no work has been initiated because our limited budgetary resources are being concentrated on higher priority activities. The Corps of Engineers continues, however, to cooperate with the South Florida Water Management District (SFWMD) in a coordinated effort to assess the effects of their ongoing river restoration activities. For instance, the SFWMD has placed three weirs, located in Pool B, in the Kissimmee River. The SFWMD coordinates testing at these weirs with the Corps.

Lake Okeechobee Area

Lake Okeechobee is a large, natural, freshwater lake located in the central part of southern Florida. With a surface area of about 730 square miles, the lake is the most prominent feature of the south Florida area and the Central and Southern Florida Flood Control Project. Due to its size and location, it is a major feature of the C&SF Project and impacts an area of over 7000 square miles. It provides substantial benefits to the area through flood control, water supply, navigation, recreation, and environmental enhancement. However, increasing concern over continued rapid growth of the south Florida area and the increasing demands for water for municipal, industrial, agricultural, and environmental purposes, coupled with an increasing concern over the lake's ecological condition, has resulted in a concerted local, State, and Federal effort to protect this vital resource.

The State of Florida has several ongoing studies of problems associated with the Lake and possible solutions to these problems. Much of this state effort has previously focused on maximizing the Lake's water supply and flood control potential. However, more recent efforts have focused on stemming the apparent accelerated eutrophication of the Lake. In particular, areas north of the lake drain via three major inlets to the lake, namely the Kissimmee River, the Taylor Creek-Nubbin Slough Basin, and the Lake Istokpoga and Fisheating Creek Basin. Previous studies have identified these areas, especially Taylor Creek-Nubbin Slough, as major sources of nutrient (phosphorus) loading to the lake. This is compounded by the previous backpumping of poor quality runoff water into the lake from the large Everglades Agricultural Area to the south. As a result of the growing concern over the adverse impacts of these discharges on the quality of the lake, numerous state plans have been developed to help divert these flows or otherwise improve inflow water quality. Some of these plans, such as the one used in the agricultural area whereby excess surface water is pumped south into the conservation areas rather than Lake Okeechobee, have been implemented or, are being tested. Others are still in the developmental stage.

Section 733 of Public Law 99-662 authorized the Secretary of the Army, in consultation with the Administrator of the Environmental Protection Agency, to study the water supply potential of Lake Okeechobee with particular emphasis on determining the causes of water quality deterioration in the lake, and the impact, if any, that the Central and Southern Florida Flood Control Project may have had on water quality in the lake. If funded, this study would be conducted in coordination with State efforts, and would be cost shared by the South Florida Water Management District.

The Corps of Engineers has aquatic plant control responsibilities on Lake Okeechobee. The Corps' aquatic plant management priority in the lake and surrounding areas is to protect navigation in the Okeechobee Waterway; therefore floating plants (water hyacinth and water lettuce) are the program's primary target species. Other major objectives include prevention of flooding which can be promoted by masses of floating plants blocking and damaging flood control structures, locks, and

gates. Additional objectives include protection of the lake fishery, wildlife habitat, and native plant community which can be displaced by the exotic species.

Floating aquatic plants are currently being managed by aquatic herbicides, mechanical harvesting, and biological control agents. All herbicides used in the aquatic plant management program are EPA-approved and have been extensively tested for safe aquatic use. Herbicides are currently, and for the foreseeable future, the most cost effective and practical method of aquatic plant control.

Everglades Area

At the south end of the Kissimmee-Okeechobee Everglades system lies the Everglades National Park. The Park has in recent years been adversely affected by unnatural water releases from the Central and Southern Florida Project, and Park officials have requested that flows delivered to the Park be redirected by way of the historic northeast Shark River Slough flow way. This would spread the water out over a wider and more natural area, and significantly reduce the impacts on the Park. Public Law 98-181 authorized the Corps to test delivery schedules to the Park other than that mandated by Public Law 91-282. The Corps, in cooperation with the South Florida Water Management District, is currently testing a delivery scheme referred to as the "rain driven model", and is preparing a report on the recommendations for a new delivery schedule and any structural modifications that may be needed to fully implement the delivery schedule.

Lower East Coast Area

The Central and Southern Florida Water Supply Study was initiated by the Corps in 1978 for the purposes of determining the extent of present or projected future water supply deficiencies in south Florida and investigating possible solutions. Several aspects of this study are complete, including reports of the feasibility of deep aquifer storage and retrieval and desalination. Two complex mathematical models have been developed. These models deal with the complex inter-relationship between surface and groundwater in south Florida and are used to assist in evaluating the impacts of structural and operational changes to the water management system with respect to general hydrological conditions and the frequency of water suply shortages. Due to the many water management initiatives in the area with respect to water quality issues, the study was overtaken by events which directly impacted water supply issues. As a result, an interim report is being prepared to summarize the findings to date.

The Hillsboro Canal, east of Conservation Areas 1 and 2, is a canal constructed about 70 years ago by the Everglades Drainage District and used by the C&SF Project as a major outlet in the Palm Beach-Broward County area. The rapid and extensive urbanization of the drainage basin has placed an increased demand on the canal for flood control. The Corps of Engineers is initiating a study, requested by the South Florida Water Management District, to determine the feasibility of increasing the outlet capacity of the canal.

Extremely rapid urbanization of Broward County has caused increasing problems with providing adequate flood protection in the area. Local officials are particularly concerned over the adequacy of the existing flood protection/water control system to prevent flood damages and contamination of the existing water supply source, the Biscayne aquifer. They requested a study, which was recently authorized and funded, to review structural and non-structural measures to improve water control in the area and reduce potential flood losses, improve water supply availability, and protect existing groundwater sources of supply from contamination. The Corps of Engineers is currently initiating a Reconnaissance Report for this study.

CONCLUSION

In conclusion, the Army Corps of Engineers is very much aware of the desires to maintain, and even restore, the unique natural resources of south Florida. Cooperative efforts currently underway by Federal and State agencies as well as interest groups and concerned individuals have resulted in actions directed toward preservation and restoration of the ecological resources of the Kissimmee River/Lake Okeechobee/Everglades system. Federal participation in such an undertaking should first be based upon a finding that use of Federal resources is justified by the expected economic and/or environmental returns. Moreover, the limited Federal financial resources available for this effort requires prioritization of Federal agency involvement in the overall effort. It is through continued cooperation among all concerned parties that maximum progress can be achieved.

This completes my statement, Mr. Chairman.

FIGURE 1. Kissimmee River — Lake Okeechobee — Everglades System

STATEMENT OF LEE A. DEHIHNS, DEPUTY REGIONAL ADMINISTRATOR OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION IV, ATLANTA, GA

Mr. Chairman and Members of the Subcommittee, my name is Lee A. DeHihns and I am Deputy Regional Administrator at Region IV of the U.S. Environmental Protection Agency (EPA), located in Atlanta, Georgia. I am accompanied today by Mr. Mike McGhee, Chief of the Water Quality Management Branch and Mr. James S. Kutzman, Chief, Groundwater Protection Branch, in our Water Management Division in Region IV.

I am pleased to be here today to describe to the Subcommittee, EPA's involvement with protection, restoration and management of the surface and groundwater resources of the Kissimmee River-Lake Okeechobee-Everglades ecosystem. EPA is involved with administering several different water management programs in the south Florida area as required by the Clean Water Act (CWA), the Safe Drinking Water Act (SDWA), Superfund and the Resource Conservation and Recovery Act (RCRA) and we work closely with numerous federal, state and county agencies, particularly with the U.S. Army Corps of Engineers (COE), the Florida Department of Environmental Regulation (FDER) and the South Florida Water Management District (SFWMD). These programs include our nonpoint source pollution control program as it relates to Lake Okeechobee, our wetlands protection program, our groundwater protection and public water supply programs, our Superfund-hazardous waste program and our involvement with several National Environmental Protection Act (NEPA) activities involving the Kissimmee River and the Modified Water Delivery Plan to the Everglades National Park (ENP).

I. HISTORICAL PERSPECTIVE

I would first like to give you a brief historical perspective of this area. The Kissimmee River-Lake Okeechobee-Everglades ecosystem is unique in the United States and is recognized nationally and internationally as a valuable, ecological resource. The Federal government recognized the value of this Everglades resource as early as 1934, and in 1947 the Everglades National Park (ENP) was established as a part of the U.S. Park Service system.

The activities of man have significantly altered large portions of the 9,000-square mile Kissimmee River-Lake Okeechobee-Everglades watershed. The main components of the alteration of this watershed have been the construction and operation of the extensive central and south Florida flood control project, conversion of large acreages of former wetland areas in the Kissimmee River flood plain and south of Lake Okeechobee to agricultural protection areas and the extensive urban expansion along the coastal upland ridge from West Palm Beach south to Miami, westward into historical portions of the Everglades. These agricultural and urban development activities have continued during the past three decades. Alternation of surface water hydrology throughout the Kissimmee River-Lake Okeechobee-Everglades drainage basin along with drainage, groundwater lowering and manipulation, pollution of the Biscayne Aquifer and eutrophication of surface water bodies and canals has occurred as a result of this development. I would now like to briefly discuss EPA's involvement with several areas of concern pertaining to south Florida's water resources.

II. LAKE OKEECHOBEE

Existing Situation/Ongoing Efforts

Lake Okeechobee is Florida's largest lake and a central feature of the Kissimmee River-Lake Okeechobee-Everglades ecosystem. The lake is used extensively and is of regional significance for flood control, water supply, sport and commercial fishing, wildlife management and navigation. Lake Okeechobee is naturally highly productive, but it is receiving excessive amounts of nutrients, especially phosphorus, and appears to be losing its ability to assimilate phosphorus. If this continues, the lake could become hypereutrophic, which could be a major environmental loss for south Florida. It has been estimated that the phosphorus loading to the lake should be reduced by at least 40%.

The Lake Okeechobee Technical Committees, LOTAC I and LOTAC II, have brought together the best available expertise to address the decline in water quality in the lake. These committees and subcommittees included representation and input from all levels of government, the regulated community, and environmental interests. A number of alternative actions to control these problems are either being implemented or are undergoing feasibility studies at this time. These actions should be addressed in detail by the SFWMD and the appropriate state agencies.

EPA Involvement

EPA, Region IV has continued to work with the SFWMD, the FDER, the Corps, and other agencies to assist in protecting and improving the water quality of Lake Okeechobee. Region IV participated in the work of the Lake Okeechobee Technical Committee (LOTAC I) by having our Nonpoint Source coordinator serve on the Kissimmee and other Basins Subcommittee. The Region is committee to providing continued support those State and Federal agencies charged with the primary responsibility for the mangement of this critical resource.

III. LOWER KISSIMMEE RIVER AND TAYLOR CREEK/NUBBIN SLOUGH

Existing Situation/Ongoing Efforts

The Lower Kissimmee River Basin and Taylor Creek/Nubbin Slough have been shown to be two of the major sources of phosphorus loading to Lake Okeechobee. Nonpoint source runoff from dairies and beef cattle farms has been identified as the probable sources of this phosphorus. These basins were named by the Lake Okeechobee Technical Committee for priority implementation of controls since they contribute significant amounts of phosphorus, and because they have identified sources of phosphorus which can be addressed with existing technology and management practices.

EPA Involvement

The Taylor Creek/Nubbin Slough watershed has been the location for a Rural Clean Water Program (RCWP) project which has resulted in the installation of best management practices (BMP's) to control nonpoint source runoff from dairies. EPA has participated in this project through its responsibility for approving BMP's.

As of part of the plan to control phosphorus from the Lower Kissimmee Basin, the Lake Okeechobee Technical Committee (1986) recommended the implementation of BMP's of a more intensive nature than those in the Taylor Creek/Nubbin Slough RCWP. These include the retention of runoff for the 25 year/24 hour storm event from high intensity use areas around dairies. EPA worked with the U.S. Department of Agriculture in the initial planning effort and aquisition of funding for this expaned RCWP project. EPA also assisted the Florida DER in the development of its regulations requiring BMP's for dairies in the Lower Kissimmee Basin.

IV. SOUTH FLORIDA SOLE SOURCE AQUIFER DESIGNATIONS

Project Description

On October 11, 1979, EPA's Administrator designated the Biscayne Aquifer as the sole or principle source of drinking water for public supply systems and individual wells in designated portions of Broward, Dade, Monroe and Palm Beach Counties. The designation included the drainage area which contributes water to the Aquifer's recharge zone. That area is within the boundaries of the South Florida Water Management District. The Sole Source Aquifer designation allows the Administrator to prohibit federal financial assistance for any project which he determines may contaminate the Aquifer so as to create a significant hazard to public health. The Sole Source Aquifer designation is particularly appropriate for the Biscayne Aquifer because of the large population which depends upon it for drinking water and because of its extreme vulnerability to contamination.

EPA Involvement

EPA's reviews of federal financially assisted projects are coodinated through the Region's review of other federal agencies' environmental impact statements. To date, the greatest benefit from the designation has been the attention it has brought to the need for state and local programs to protect an irreplaceable resource. Much has been accomplished since the designation in 1979. EPA and local governments in southestern Florida developed the Biscayne Aquifer Protection Plan in 1985 to address waste management practices in the area. Additionally, Dade, Broward and Palm Beach Counties have all developed local Wellhead Protection Programs to manage waste generating activities and land use proximal to their well fields. The FDER also addresses ground water protection in this area through their statewide Wellhead Protection Program (G-I Rule) which targets major municipal wells in unconfined or leaky confined aquifers.

V. WELLHEAD PROTECTION PROGRAM

Background

The Wellhead Protection Program (WHP) was established by the Safe Drinking Water Act Amendments of 1986. The Act required States to develop and implement programs to protect the area surrounding public water supply wells from contamination. Congress authorized EPA to issue grants to participating States and required EPA to prepare guidance to States for applying for grants and guidelines for delineating WHP areas. These materials were made available in June 1987.

Federal and State Program Status

The Agency continues to develop technical assistance documents and provide other technical assistance to the States and local governments in support of their WHP activities. The State of Florida has developed a Wellhead Protection Program and is now mapping protection zones around major municipal wells in unconfined or leaky confined acquifers as required by FDER's G-I Rule.

Local Program Status

Currently, three Florida counties have established local WHP Programs (Dade, Broward and Palm Beach) and two others (Alachua and Collier) are in the process of developing programs. EPA Region IV personnel assisted in the drafting to Dade County's Northwest Wellfield Protection Ordinance.

VI. STATE OF FLORIDA UNDERGROUND INJECTION CONTROL PROGRAM

Background: Section 1421 of the Safe Drinking Water Act mandates the establishment of minimum requirements to protect underground sources of drinking water (USDW) from subsurface emplacement of fluids by well injection. The Underground Injection Control (UIC) regulations promulgated in the Federal Register state that all aquifers or portions of aquifers yielding water containing 10,000 or less miligrams per liter (mg/l) of total dissolved solids and containing a sufficient quantity of water to supply a public water system be designated for protection of water to supply a public water system be designated for protection as USDWs. All injection operations, whether injecting into a USDW, or other formations, must comply with the various construction, operating, monitoring and reporting requirements specified in the UIC regulations.

Status: The Florida UIC primacy application for Class I, III, IV and V wells was approved by the Administrator on February 7, 1983, as containing the minimum program requirements to assure that underground injection will not endanger drinking water sources. The State of Florida was delegated primary enforcement responsibility for all underground injection activities in the State except for Class II wells. EPA has maintained overview responsibility of the State run UIC program to assure that the State's administration of the program is consistent with all applicable State and Federal statutes, regulations and policies.

VII. AQUIFER STORAGE AND RECOVERY DEMONSTRATION PROJECT

Project Description

In accordance with the Lake Okeechobee Interagency Memorandum of Understanding, the SFWMD has designed an aquifer storage and recovery (ASR) project to test the feasibility of injecting canal water into the upper Floridian Aquifer for storage, treatment and future recovery. The pilot project will be located at the intersection of S.R. 710 and L-63(N) Canal in Okeechobee County (Taylor Creek ASR Project). If the ASR project is a success, this technology may have application as a means of reducing nutrient inputs to Lake Okeechobee. Also, an expanded ASR program has the potential to reduce the quantity of water diverted south of Lake Okeechobee, and may reduce associated adverse impacts on the Water Conservation Areas and Everglades National Park.

EPA Involvement: Introduction of the canal water into the Floridian Aquifer will involve the use of an injection well which must meet the minimum requirements of the federal Safe Drinking Water Act and implementing regulations. Primary responsibility for regulating these types of wells has been delegated to the State. EPA's responsibility is to overview the State's actions to assure that the well does not inject fluids into an underground source of drinking water which would cause a violation of a national drinking water standards or adversely affect the public health.

VIII. WETLAND PROTECTION PROGRAM

Program Description

The Section 404 permit program regulates discharges of dredged or fill material into waters of the United States, a term which includes most wetlands. This program is co-administered by EPA and the Department of the Army acting through the Corps of Engineers. The Corps is given the responsibility under the Act to coordinate the review of permit applications and, based on this review, to decide whether a particular permit should be issued. The Act requires that in makng this decision, the Corps apply the environmental critiera contained in the Section 404(b)(1) Guidelines developed by EPA in conjunction with the Department of the Army.

During the permit review process, EPA provides comments to the Corps that focus on EPA's evaluation of project compliance with the Guidelines. The Corps considers these comments in conjunction with their own evaluation and the comments of other agencies and the public in reaching a permit decision. In those instances where disagreements develop between EPA and the Corps, the decision to issue a permit may be elevated to the Assistant Secretary of the Army under the terms of a Memorandum of Agreement pursuant to Section 404(g). EPA is also given the final authority under Section 404(c) to restrict or prohibit the use of a wetland site for the discharge of dredged or fill material after making a determination that such discharge could result in unacceptable adverse effects. Region IV's wetlands program has been actively involved with the Corps, the FDER, the SFWMD and the U.S. Fish and Wildlife Service (FWS) in administrating the wetland dredge/fill program in the Everglades. EPA is committed to protecting, restoring and enchancing the remaining portions of the Everglades.

Background

A large majority of the wetland losses in the Everglades occurred prior to the creation of the 404 program by the Federal government in 1972. Recent estimates indicate that since the turn of the century approximately 40% of south Florida's freshwater sawgrass marshes, sloughs and wetland prairies have been converted or lost. Historically conversion of Everglades wetlands to agricultural and urban development represents some of the largest wetland losses in the Southeast and the country. Reductions of fish and wildlife populations in the Kissimmee River corridor south into Everglades National Park have been documented by numerous ecological studies.

EPA Involvement

The Corps began exerting jurisdiction over wetland filling projects in the Everglades in 1977. As a result of the westward expansion of the urban areas along the coast, particularly in the Miami area, East Everglades wetlands have been under intense developmental pressure. EPA Region IV has worked closely with the Jacksonville Corps District, the FWS, and property owners in evaluating numerous Everglades wetland dredge/fill permit applications and unauthorized filling enforcement cases. Many proposals to fill high quality wetlands have been either denied by the Corps or withdrawn by the applicants. Through application of the Section 404(b)(1) Guidelines, which provide the environmental criteria by which dredge/fill proposals are evaluated by the Corps and EPA, adverse impacts associated with many dredge/fill proposals have been minimized and unavoidable impacts have been mitigated.

Recently EPA Region IV initiated a Federal 404(c) action on three wetland properties in the East Everglades totaling 432 acres to protect these wetland tracts from being converted to agricultural fields. The tracts are located near the eastern border of the Everglades National Park. Region IV is hopeful that our firm commitment to maintaining viable Everglades wetlands, in cooperation with fellow county, state, and federal environmental review agencies, will send a clear message to the public that the time has come to protect the Everglades, not exploit it. EPA strongly supports the recent proposal by the State of Florida and the Department of the Interior to purchase 75,000 acres of wetlands in the East Everglades Northeast Shark River Slough, which borders the ENP.

Region IV is working closely with the Corps, SFWMD, and ENP officials in designing and evaluating the Modified Water Deliver Plan to ENP to restore natural hydrological flows to the Park. EPA strongly supports the ecological restoration plans for ENP. Of great concern to EPA is the proposed 150 million gallon per day West Dade Wellfield, which has been tentatively planned for construction in the Northeast Shark River Slough area of the East Everglades. Through our participation in Dade County's West Wellfield Technical Advisory Committee, EPA has strongly recommended to Dade County that the proposed wellfield not be located in

the Northeast Shark River Slough, in order to avoid serious adverse impact to wetland habitat and ENP. Region IV will continue to work closely with Dade County and SFWMD to site the wellfield in a location which will minimize adverse wetland impacts while providing the citizens of Dade County with clean, safe potable water.

Region IV is also working closely with Corps and Dade County personnel, as well as SFWMD and FDER staff, on an Advanced Identification-Special Area Management Plan (SAMP) in the 14-square mile Bird Drive-Everglades Basin, west of Miami. The Bird Drive-Everglades Basin is a wetland area, which has been adversely impacted by drainage and exotic vegetation infestation. The Bird Drive-Everglades Basin Advanced Identification-SAMP process is an interagency planning tool with the goal of balancing development in environmentally altered wetlands with protection and enhancement of other wetlands in or near the basin. EPA considers the Advanced Identification-SAMP process in the Bird Drive-Everglades Basin area as a useful approach to allow environmentally sensitive development while also providing for wetland management/enhancement.

EPA fully supports the restoration work being accomplished by the SFWMD associated with the Kissimmee River Restoration Demonstration Project. This restoration work relates to improving fish and wildlife habitat and function and water quality conditions in the Kissimmee River-Canal C-38 corridor, where the original 98-mile long Kissimmee River was channelized to form the 48-mile long C-38 canal for flood control purposes. We understand that monitoring work being done by the State to assess ecological benefits associated with the demonstration project indicates that fish and wildlife enhancement efforts have been successful without diminishing flood control protection. Region IV feels that additional proposed fish and wildlife enhancement work on the Kissimmee River-C-38 canal would greatly benefit previously damaged fish and wildlife resources in the Kissimmee River.

IX. SOUTH FLORIDA SUPERFUND PROGRAM

Status

Under the Superfund program, EPA is presently investigating approximately 440 suspected uncontrolled hazardous waste sites in the 17 counties in the Kissimmee River-Lake Okeechobee-Everglades basin. These sites are evaluated based on their potential to affect public health and the environment. This evaluation, called the Hazard Ranking System (HRS), considers the potential for any hazardous substances found at the site to come in contact with persons in the area, to contaminate drinking water sources, to cause air contamination, or to directly affect sensitive environments. Sites scoring over 28.5 on the Hazard Ranking System are submitted for addition to the National Priorities List (NPL) which makes them eligible for Superfund clean up monies. Superfund monies can also be used when emergency clean ups are necessary. Low scoring sites are referred to other Federal, state, or local authorities for possible clean up actions. In the 17 counties covering this area of Florida, there are presently 13 sites on the National Priorities List with the possibility of 10 new sites to be added in the next NPL update.

EPA Region IV also works closely with the FDER to regulate hazardous waste generating facilities through the RCRA permitting and compliance program in the south Florida area.

Mr. Chairman, we at EPA are committed to the protection, enhancement and restoration of the surface and groundwater resources of the Kissimmee River-Lake Okeechobee-Everglades basin. I will be pleased to answer any question you or the Subcommittee members have relative to these matters.

[Subsequent to the hearing, additional questions from Representative Arlan Stangeland were submitted to Messrs. Ducret, Dola, and DeHihns. The questions and responses follow:]

U.S. DEPARTMENT OF THE INTERIOR,
GEOLOGICAL SURVEY,
Reston, VA, July 6, 1988.

Hon. HENRY J. NOWAK,
Chairman, Subcommittee on Water Resources, Committee on Public Works and Transportation, House of Representatives, Washington, DC.

DEAR MR. CHAIRMAN: The enclosed responds to Representative Arlan Stangeland's May 27, 1988, letter to Mr. G. Louis Ducret, Jr., the Chief of our Water Resources Division Subdistrict Office in Miami, in which he asked that we answer followup questions to the May 20, 1988, hearing held in Fort Lauderdale, Florida, on the Everglades/Lake Okeechobee/Kissimmee River ecosystem. Our response should

be prefaced by identifying two key areas of the ecosystem in which the U.S. Geological Survey has limited involvement:

Lake Okeechobee—we conduct studies and collect data on inflow, outflow, and perimeter waters, but we have no active programs in the Lake itself.

Everglades National Park—we deal with inflow and perimeter waters, but are not currently active within Park boundaries.

Thank you for the opportunity to provide this information to you for inclusion in the official hearing record.

Sincerely yours,

DALLAS L. PECK,
Director.

Enclosure.

ANSWERS TO QUESTIONS FROM THE SUBCOMMITTEE ON WATER RESOURCES PROVIDED BY G. LOUIS DUCRET, JR., CHIEF, MIAMI SUBDISTRICT OFFICE, WATER RESOURCES DIVISION, U.S. GEOLOGICAL SURVEY

1. Mr. Ducret, your testimony indicates that less than 2 percent of the surface water of the Everglades National Park shows detectable levels of pesticides but that 80 percent of bottom sediments tested showed pesticide residue. To what do you attribute this disparity? Also, what testing have you done of pesticides in ground water?

The disparity between pesticides detected in surface waters and those detected in bottom sediments occurs because chlorinated hydrocarbons degrade little and are bound to the organic fraction of the sediments by ionic attraction, covalent bonding, adsorption, and entrapment. The possibility of these compounds reentering the water column is relatively small because they are physically and chemically bound to the bottom material. They can be assimilated into living plant cells and thus be incorporated within the cells. Physical and chemical binding into the sediments and residual accumulation in decomposed plant material in the sediment makes the bottom material a "sink" for chlorinated hydrocarbon insecticide residues.

As a matter of practice in the Miami Subdistrict Office, most ground-water quality sampling routines include some pesticide determinations. Water quality sampling at ambient ground-water sites in the shallow aquifer system has not detected insecticide residues. However, sampling at sites where insecticides have been known to be directly applied, such as an agricultural area, has detected traces of insecticide residues.

2. Could you give the Committee the benefit of your views on the interrelationship of surface and ground water? To what extent is nutrient loading of surface water affecting ground water supplies?

The movement of water in South Florida is greatly affected by the presence of a shallow ground-water table which is, in turn, affected by both natural and manmade (canals) surface channels, natural and manmade surface impoundments (Lake Okeechobee and the Conservation Areas), and surface sheet flow into the Everglades during the rainy season. A management system has developed over a period of decades to achieve the delicate balance needed to maintain ground-water levels, prevent flooding, ensure a fresh drinking water supply, prevent saltwater encroachment in the aquifer, and provide water for farming.

A key to the management of the South Florida Water system is the hydraulic connection between canals and the Biscayne aquifer. This interconnection brings both benefits and problems. The benefits are: (1) Flood prevention by the rapid removal of excess water to the ocean through operation of control structures in canals; and (2) the movement of ground water from the interior to the coastal areas where it can infiltrate the aquifer and maintain high water levels to retard saltwater intrusion into well fields. Problems related to good aquifer-canal interconnection are: (1) The movement of saltwater into the aquifer along the coast and tidal canals during times of low water; and (2) the threat of pollutants, such as nutrients, entering the canal system and moving long distances before reentering the aquifer.

The extent that nutrient loading of surface waters affects ground-water supplies is dependent upon a number of factors. Contribution of pollutants to the aquifer and to canals in the urban areas is minimal during the dry seasons. However, moderate-to-heavy, infrequent storms and consequent surface runoff and infiltration can result in buildup of nutrients and other pollutants in shallow parts of the aquifer and in canals. These infrequent contributions tend not to be "flushed" because canal control structures are generally closed in order to prevent saltwater intrusion in the aquifer or upstream in the canals. Other contributions to canals are from inflow of ground water in the upgradient areas which contain nutrients from the

use of fertilizers in residential areas and from septic tank effluent. Thus, some infiltration into the aquifer takes place in the downgradient reaches of canals where the canal water levels are higher than the ground-water level.

3. Has USGS done any work in the South Florida area on artificial recharge. If so, what are your findings?

The USGS in South Florida has a number of reports on several aspects of artificial recharge. The three most prevalent methods of artificial recharge which have been, or are being, considered in this area are known locally as aquifer storage and recovery, backpumping, and regulation of water levels in storage areas.

At a number of sites in South Florida we have investigated the injection of excess fresh water during the rainy season from the shallow aquifer system into a deeper artesian saline aquifer system. This process is known as "aquifer storage and recovery" because the fresh waters that are stored during the rainy season are then recovered when required during the dry season. The feasibility of using this method is presently under consideration by water management agencies.

The second artificial recharge method. "backpumping," refers to reversing the flow in the canal system so that, instead of discharging to tide waters, water is discharged back into the Everglades or Lake Okeechobee for storage. In this process, additional water also infiltrates into the aquifer. The pros and cons of "backpumping" are also under consideration by water management agencies.

The third artificial recharge method, "the regulation of water levels in storage areas," involves the use of surface-water management practices to regulate water levels in the surficial aquifer. This is the most prevalent method of artificial recharge in South Florida. The U.S. Geological Survey has done and continues to do a great deal of work involving this method. The findings of such studies fill volumes, but we might cite, as an example, the results of a study of Broward County to quantify seepage from Water Conservation Area 2B into the adjacent canal and into the regional ground-water flow system. A 5.64-foot head differential between water levels in Conservation Area 2B and water levels in the adjacent L-35A canal caused water to leak into the canal at an average rate of about 1 gallon per minute per linear foot of canal, thus accounting for the reduction of 0.013 feet per day in water levels in Conservation Area 2B. In this study, it was calculated that 187,000 gallons per minute of surface water flowed under the levee and entered the regional ground-water flow system.

4. Is USGS doing any work in the area on the causes and consequences of nutrient loading of surface and ground water in the area? If so, could you describe that work?

The U.S. Geological Survey is not now doing any work in the area of nutrient loading of surface and ground water. However, in the recent past a number of studies were done in which nutrient loads in surface waters were analyzed. Reports on these studies are available for the Everglades Conservation Areas and the Caloosahatchee River basin.

In general, our studies show that water pumped from the Northern Everglades area often has relatively high concentrations of inorganic nitrogen and phosphorus which are then transported in the canals or move into the peripheral marshes. As this water infiltrates the aquifer, concentrations of nitrogen and phosphorus decrease sharply within 100 meters or less of the canals, whereas total mineral content (as indicated by measurements) remains essentially unchanged within that distance. The sharp decrease in inorganic nitrogen and phosphorus nutrients near the canal indicates net uptake (utilization of nutrients by organisms) in these shallow waters.

DEPARTMENT OF THE ARMY,
OFFICE OF THE ASSISTANT SECRETARY,
Washington, DC, June 28, 1988.

Hon. ARLAN STANGELAND,
Ranking Minority Member, Subcommittee on Water Resources, Committee on Public Works and Transportation, House of Representatives, Washington, DC.

DEAR CONGRESSMAN STANGELAND: Thank your for your June 2, 1988, letter, regarding the May 20, 1988, hearing in Fort Lauderdale, Florida, concerning the Everglades/Lake Okeechobee/Kissimmee River ecosystem.

I, too, found the hearing helpful and productive and was much impressed by the diligent and constructive questioning by the Chairman and members of the Subcommittee on Water Resources, Committee on Public Works and Transportation. It was an honor for me to present the views of the Department of the Army on this important area of our Nation—an area where the Army Corps of Engineers has played a

key role in water resource development—and to have participated in the May 20th hearing as a member of the Federal panel.

The questions which you enclosed with your letter have been answered and a copy of the questions and answers is enclosed. As you suggested, we are providing a copy of the answers to your questions directly to Mr. Joseph A. Italiano, Editor for the Committee on Public Works and Transportation.

Sincerely,

G. EDWARD DICKEY,
Deputy for Program Planning, Review and Evaluation.
(For Steven Dola, Deputy for Management and Budget).

Enclosure.

QUESTIONS AND ANSWERS FOR CONGRESSMAN STANGELAND ON LAKE OKEECHOBEE

1. A. Could you describe the Corps' preliminary findings with respect to the solutions to the eutrophication problem in Lake Okeechobee?

The Corps preliminary findings with respect to solutions to the eutrophication problem in Lake Okeechobee are as follows: There has been a significant increase in nutrient loads to the lake since 1973. In a system as large as Lake Okeechobee, the sources of nutrients in the watershed are extremely varied; however, the preponderance of nutrients (phosphorus) comes from dairy farms north of the lake via the Taylor Creek-Nubbin Slough watershed. The principal way to reduce the eutrophication problem is to reduce the total amount of nutrients flowing into the lake. While the lake is not expected to go hypereutrophic soon, it is reasonable to believe that continued flow of nutrient rich water into the lake will cause extensive plant and algae growth eventually limiting future beneficial use. The State of Florida is conducting extensive research into the lake to determine its trophic state and to better understand how the system functions.

B. What are the options available in addressing the problem?

There are four main options under investigation by the State of Florida.

1. *Best Management Practice.*—These are activities which treat the nutrient problem at the source and are being strongly pursued on dairy farms in the Taylor Creek-Nubbin Slough and lower Kissimmee River watersheds.

2. *Diversion Plans.*—Plans to divert nutrient laden waters away from the lake are under investigation by the State. In general, these plans tend to transfer the problem from one area to another and, accordingly, have been strongly opposed.

3. *Aquifer Storage and Retrieval.*—The State is investigating the possibility of injecting runoff into the brackish zone of the artesian Floridian Aquifer. This option could be used for both disposal and water supply, depending on the location and need. This is a new technology still in the research stage.

4. *Chemical and Biological Treatment.*—This option received some initial attention, but has generally been dropped as impractical due to the large volumes of water that would require treatment.

C. What are the relative costs and benefits, and what appears to be most cost effective?

Best Management Practice is the most cost-effective option available, but is not implementable by the Corps. Diversion is expensive and, while effective for the lake, is generally opposed due to the transfer of impacts. Aquifer Storage and Retrieval is a relatively new technololgy which has yet to be proven effective. It also could generate opposition by putting nutrients into the Floridian Aquifer. Treatment is impactical except at point sources such as sewage treatment plants.

2. A. What is the Corps' view on the causes of eutrophication?

The cause of the accelerated eutrophication is the gradual increase in nutrient loads to the lake. More specifically, phosphorus loading has been estimated to have doubled in the last ten years.

B. Where are the nutrients coming from and where do we need to focus our attention in dealing with the problem?

All of the inflows to the lake show high nutrient loads. However, attention now is being focused on the primary source of nutrients to the lake, the dairy farms in the Taylor Creek, and Nubbin Slough basins north of Lake Okeechobee. Other areas such as the Lower Kissimmee River, Fisheating Creek, Harney Pond/Indian Prairie, and the Everglades Agricultural Area are being monitored to assess local nutrient inputs. In addition to the dairy farms, improved beef pastures, sugarcane, and vegetable farms discharing into those inflows are also under scrutiny.

3. Has the Jacksonville District or the South Atlantic Division recommended a project under the Section 1135, environmental enhancement program?

During formulation of the Army Civil Works budget request for Fiscal Year 1989, the Assistant Secretary asked the Corps to review its program and nominate candidates for possible funding. In response, the Jacksonville District submitted a proposal nominating the Kissimmee River as demonstration projects under Section 1135 of the Water Resources Development Act of 1986. However, budget constraints and competing priorities precluded including any such proposals in the President's Fiscal Year 1989 budget request.

4. What has been done thus far to implement the study of the Lake Okeechobee ecosystem authorized by Section 733 of the 1986 Water Resources Development Act?

This study has not been strongly supported by the South Florida Water Management District; therefore, funds to initiate have not been requested. In addition, the study does not meet current budgetary criteria for high priority studies.

5. Could you describe the Corps' capability with respect to computer modeling of the ecosystem?

The Corps has capability for modeling various components of the ecosystem, including flow diversions, wetland restorations, and water quality. The Waterways Experiment Station has on its staff individuals familiar with use of at least 10 one-dimensional and two-dimensional water quality models. This includes CE-QUAL-W2 and the modified Vollenweider Model presently recommended for use in the lake by the Lake Okeechobee Technical Committee (Reference WOTS Information Exchange Bulletin Vol E-87-1, Mar 87). The Jacksonville District currently maintains an extensive water quality data base on the lake that may be used as preliminary input to the modeling effort. Modification of IEC models has been used to evaluate flow diversions, flood impact analysis, and environmental restoration efforts within the Kissimmee River Basin adjacent to Lake Okeechobee. This basin provides 30 percent of the local inflows to the lake.

6. What is the status of wetlands generally within the Lake Okeechobee ecosystem; are the Corps' wetland mitigation and creation activities beneficial; and what more could be done in this area?

There has been a reduction of wetlands within the Lake Okeechobee ecosystem and this loss is of great concern to State and local interest groups. This wetland loss has been associated with degradation of Lake Okeechobee's water quality. Changing land use activities within the region has had an adverse impact on basin water quality and this fact has necessitated improved land use controls by State and local governmental agencies. Current restoration efforts within the basin's ecosystem by the State are an attempt to regain increased wetland acreages for both water quality gains and an improved fish and wildlife habitat.

No Corps wetland mitigation and creation activities have been performed to date on the lake. The health and well-being of the lake may depend on the lake's littoral zone, which some believe plays a role in the nutrient dynamics of the lake. Efforts are underway by State interests to address the zone's influence. Proposals have been made by local interests to lower lake levels in the belief that such an action would "revive cleansing shoreline marshes." However, there is not a consensus of opinion on the desirable water levels for the Lake Okeechobee marsh, nor is there a consensus of opinion on the water quality and trophic state of the lake. The proposals to lower the lake regulation schedule would adversely impact the authorized project purposes of irrigation, water supply, navigation, salinity control, and water supply to Everglades National Park.

HOUSE OF REPRESENTATIVES,
Washington, DC, June 2, 1988.

Mr. STEVEN DOLA,
Deputy of Management and Budget, Office of the Assistant Secretary of the Army (Civil Works), Washington, DC.

DEAR MR. DOLA: During the Friday May 20th hearing in Fort Lauderdale, Florida, you testified on the condition of the Everglades/Lake Okeechobee/Kissimmee River ecosystem. As I indicated at that hearing, I had a number of questions that were not asked in person but which I would like to have answered for the record. The questions are attached. Please provide a written response within the next two weeks, if possible, and a copy to Joseph A. Italiano, editor for the Committee.

I would also like to commend you on your excellent testimony during the hearing. I hope you found the hearing as helpful and productive as I did.

With kind regards,

Sincerely,

ARLAN STANGELAND,
Member of Congress.

Attachment.

QUESTIONS FOR THE CORPS (MR. DOLA)

1. Could you describe the Corps' preliminary findings with respect to the solutions to the eutrophocation problem in Lake Okeechobee? What are the options available in addressing the problem? What are the relative costs and benefits? What appears to be most cost effective?

2. What is the Corps' view on the causes of eutrophocation? Where are the nutrients coming from and where do we need to focus our attention in dealing with the problem?

3. Has the Jacksonville District or the South Atlantic Division recommended a project under the Section 1135, environmental enhancement program?

4. What has been done thus far to implement the study of the Lake Okeechobee ecosystem authorized by Section 733 of the 1986 Water Resources Development Act?

5. Could you describe the Corps' capability with respect to computer modeling of the ecosystem?

6. What is the status of wetlands generally within the Lake Okeechobee ecosystem? Are the Corps' wetland mitigation and creation activities beneficial? What more could be done in this area?

U.S. ENVIRONMENTAL PROTECTION AGENCY,
REGION IV,
Atlanta, GA, June 21, 1988.

Ref: 4WM/WQMB/RFM.

Hon. ARLAN STANGELAND,
House of Representatives, Washington, DC.

DEAR MR. STANGELAND: I am pleased to provide responses to the questions contained in your June 2, 1988, letter concerning the Everglades/Lake Okeechobee/Kissimmee River. Our responses are enclosed and will hopefully be of value to you and the Committee.

I would like to reiterate the Environmental Protection Agency's commitment to protecting within our abilities this invaluable national resource. Please call on me if I can provide further information.

Sincerely yours,

LEE A. DEHIHNS,
Deputy Regional Administrator.

Enclosure.

EVERGLADES/LAKE OKEECHOBEE/KISSIMMEE RIVER ENVIRONMENTAL PROTECTION AGENCY RESPONSES

1. What do you envision as the best approach to reducing the phosphorus loading of Lake Okeechobee by 40 percent and what is a realistic time frame for such reductions?

The Environmental Protection Agency (EPA) supports the recommendations of the Lake Okeechobee Technical Committee (August 1986) and the Lake Okeechobee Technical Advisory Council Interim Report to the Florida Legislature (February 29, 1988) concerning the best approach to achieving this objective. These committees recommend a program of agricultural best management practices, diversion of nutrient-laden waters and aquifer storage and recovery. Agricultural best management practices should be implemented and accelerated where possible in the Taylor Creek-Nubin Slough and the Lower Kissimmee River Basins. Aquifer storage and recovery is a promising technique for reducing discharge and capturing phosphorus from the Taylor Creek-Nubin Slough Basin, however, the use of this technique depends on the outcome of a demonstration program. Diversion of Taylor Creek-Nubin Slough away from the lake will only be considered after the completion of extensive studies to determine the impacts of this alternative. In addition, continuation of the Interim Action Plan is recommended, which eliminates the backpumping of nutrient-rich water from the Everglades Agricultural Area. However, the reduction of nutrient loading from these waters to the Everglades is also recommended.

Experts report that the phosphorus concentration in Lake Okeechobee has doubled in the past decade and that the lake appears to be losing its ability to assimilate phosphorus. It is believed that the recommended measures for reducing phosphorus loading to the lake should result in major advances toward this goal while providing an opportunity to better develop other strategies for later implementa-

tion. Due to the many uncertainties that exist concerning the efficacy of these measures, the experts are unwilling to place a time frame on achieving the phosphorus reduction goals.

2. Describe the technologies and practices and the costs of addressing non-point source runoff from dairies and beef cattle farms in the Lower Kissimmee Basin and the Taylor Creek-Nubin Slough area.

The best management practices for the Lower Kissimmee River Project were selected to capture runoff from dairy holding areas and milking barns, then applying it to some type of cropping system. Also, cattle will be fenced from streams and improved pastures will be managed to reduce nutrients and fertilizers in runoff. The strategy is to recycle all nutrients produced on the farm.

All runoff from intensive holding areas where the milking herds are kept will be collected in a holding pond. Barn waste will be collected in the lagoon systems. Both of these collection systems will then be used to irrigate some type of cropping system so that the nutrients collected can be recycled by plants. Applications of fertilizer will be split to maximinze plant uptake and soil samples will be required to determine exact needs. Pastures and holding areas will be limed to insure an optimum pH for nutrient uptake. Streams and major ditches will be fenced to prevent direct discharge from animals and provided with vegetation filter strips to reduce runoff from lower-animal-density pastures. Portable shades and watering facilities will be used to keep animals away from streams and low areas. The Lower Kissimmee Basin project area contains a number of beef cattle ranches and large dairies.

There are 15,500 acres estimated to be critical in the basin and this area contains 15 dairies with 19 milking barns. The total cost of the project is estimated at $4.7 million with $1.25 million from Rural Clean Water Program (RCWP) funds. The State of Florida has committed $2,570,000 for best management practices on these dairies.

3. Has EPA looked at the use of artificial wetlands to control point and nonpoint source pollution? What is your assessment of how cost effective artificial wetlands might be in responding to phosphorus and nitrogen loading? EPA has funded research and demonstration artificial wetlands treatment systems for many years. There are more of these systems in Florida than any other state. The systems perform very well and are often the best alternative available. The systems, of which there are many types, are very effective in removing both nitrogen and phosphorus. Some of the larger systems include the City of Orlando and Walt Disney World.

4. To what extent can nutrient-rich water be used to recharge threatened or declining aquifers? Do underground limestone formations provide adequate treatment of phosphorus and nitrogen?

4a. The Safe Drinking Water Act (SDWA) of 1974 required the development of an underground injection control (UIC) Program to establish minimum federal standards for injection wells. Subsequently, the EPA promulgated UIC regulations which set specific requirements for the construction and operation of injection wells to assure projection of underground sources of drinking water (USDW).

CFR 144.12(a) of the SWDA prohibits the injection of any fluid which might violate any primary drinking water standards or otherwise adversely affect the health of persons. Therefore, recharge to an aquifer classified as a USDW may be initiated only if the recharge water does not violate any primary drinking water standards or exceeds EPA health based standards for any parameter which may adversely degrade the aquifer.

4b. Literature exists that suggests phosphorus may combine with calcium ions in solution to form certain types of calcium phosphates which would settle out of solution. Reports on recharge water in this area indicate its slightly corrosive nature will dissolve to some degree the calcium in the limestone which is predominantly calcium carbonate. Increasing the amount of calcium ions in solution will in turn increase the amount of calcium phosphates generated. This reaction, however, is dependent on contact time between the calcium and phosphorus. Contact time in this area will be limited due to the limestone formations nature.

There is no available documentation that suggests limestone will offer any treatment of nitrogen or associated nitrogen compounds. No discernable reaction or binding of soluble nitrogen with calcium ions will occur in this system as previously discussed with phosphorus and calcium. Dilution of nitrogen levels by the native water in the aquifer will occur, but dilution by itself could not be considered adequate treatment. EPA has set health based limits on nitrogen as nitrate (10 mg/1) and as nitrite (.02 mg/1) because of the documented harmful effects of the parameters on the health of persons, especially young children and pregnant women. It is our position that any proposed charge water meet these limits prior to injection.

5. Could you elaborate on the 404(c) veto actions involving proposed development of 432 acres in the East Everglades?

On April 22, 1987, the EPA Region IV office in Atlanta, Georgia, initiated action under Section 404(c) of the Federal Clean Water Act to protect three wetland properties, totaling 432 acres, where rockplowing projects had been proposed or were anticipated in Florida's East Everglades. If finalized, this action could prevent issuance of section 404 permits for these projects.

"Rockplowing" converts seasonally inundated pinnacle-rock prairie wetlands into fields suitable for agriculture. A bulldozer drags a plow-like implement over the surface, breaking it up to make the land smooth and level enough for vegetable crops during the winter dry season. The result is the destruction of valuable wildlife habitat and major disruption of the food chain production and water purification functions provided by the wetlands.

About 55 percent of the wetlands extant in the lower 48 states in Colonial times have been lost, largely due to human activity. Since the turn of the century, approximately 40 percent of South Florida's freshwater wetlands have been destroyed, and a significant additional acreage has been adversely affected by drainage. Despite the public's current heightened awareness of wetland values, approximately 300,000 acres of wetlands still are being lost every year, some 96 percent of which are freshwater type. Agricultural conversion accounts for about 87 percent of freshwater wetland losses nationwide.

A public hearing on Region IV's proposed Section 404(c) action was held on November 18, 1987, in Homestead, Florida, near the East Everglades, to provide property owners, governmental agencies, and the public an opportunity to comment of EPA's proposal to deny federal authorization for the conversion projects. On February 9, 1988, Region IV forwarded it's Recommended Determination on the East Everglades 404(c) action to EPA Headquarters recommending denial of proposals to rockplow the 432 acres of wetland. A final agency determination on the regional recommendation was made by the Assistant Administrator for Water on June 15, 1988.

6. Has the Lake Okeechobee ecosystem received any assistance under the Clean Water Act's Section 314 Clean Lakes Program in the past?

The Lake Okeechobee ecosystem has not received Section 314 Clean Lake Program funding. The only active Florida Clean Lakes Grant is Lake Jackson which was completed this fiscal year.

7. Despite the lack of funding, has the State or EPA carried out any activities under the Section 319 Nonpoint Source Pollution Program? Has the section 205(j) set aside for nonpoint source pollution been used?

7a. Under Section 319, the State of Florida is preparing a Nonpoint Source Assessment Report and Management Plan. Once the Management Plan is approved, Section 319 implementation activities will be carried out with available funds. However, the State of Florida, through the newly implemented Surface Water Improvement and Management (SWIM) Program, has identified Lake Okeechobee as a priority water body. The local water management district is in the process of preparing a management plan.

7b. No Section 205(j)(5) funds have been directly used for the Lake Okeechobee system, however, funding is being used to develop the State Nonpoint Source Assessment Report which would include the Lake Okeechobee system.

8. To what extent is point source pollution a problem? Has nonpoint source pollution increased over the years? Are there any notable trends?

8a. The Lake Okeechobee technical committee identified four municipalities surrounding the lake as contributors of approximately 26–29 tons of phosphorus per year through their wastewater effluents. The Florida Department of Environmental Regulation has a program underway to accomplish control of these sources.

8b. Nonpoint source pollution has increased over the years in the critical basins as the number of dairies and cattle farms and the number of animals have increased.

8c. An analysis of wate quality trends in Lake Okeechobee's limnetic zone shows that total phosphorus and orthophosphate concentrations have increased significantly since 1973. Another important trend is the declining nitrogen-phosphorus ratio. This is significant because declines in the N:P ratio are related to shifts from green algae to blue-green algae species which are not ecologically desirable in high concentrations.

9. What is the EPA's view with respect to the inter-relationship between surface and ground water in the area? Both surface and ground water represent important resources to the area in question. Each resource can serve common needs if necessary. Over reliance on either resource for the needs of the area could lead to deple-

tion of that resource both in quality and quantity. It would be most beneficial to clearly identify all the needs of the area and decide which resource, surface or ground water, can best serve that need.

10. What health threats does phosphorus contamination pose in the context of drinking water?

Finished public drinking water contains little phosphorus (mg/liter concentrations). Daily foods provide more than one gram of phosphorus per day. It can be concluded that phosphorus levels pose little health threats in finished water.

Fertilizers containing phosphates contribute to nonpoint source pollution of raw water reservoirs for drinking water supplies. This phosphate would only add nutrients to a raw water reservoir for possible increases in bacteriological populations. The possible increase could be handled through normal water treatment processes.

Mr. NOWAK. We will now move on to—I think we will join the state government here, who is represented by South Florida Water Management District, Mr. Tilford Creel, who is the Deputy Executive Director. We will have at the table joined with local government representatives of Broward County Water Management Division, Mr. Roy Reynolds who is the Director and the Dade County Division of Environmental Resource Management, Mr. Doug Yoder, who is the Assistant Director.

Gentlemen, welcome to the hearing and I know that you were here for the federal panel, and their presentation of material, and I would hope that they gave you adequate technical assistance upon which to make some local judgments. Mr. Creel, I will let you have the floor for your statement.

TESTIMONY OF TILFORD CREEL, DEPUTY EXECUTIVE DIRECTOR, SOUTH FLORIDA WATER MANAGEMENT DISTRICT; ROY REYNOLDS, DIRECTOR, BROWARD COUNTY WATER MANAGEMENT DIVISION; DOUG YODER, ASSISTANT DIRECTOR, DADE COUNTY DIVISION OF ENVIRONMENTAL RESOURCE MANAGEMENT; AND MICHAEL FINLEY, SUPERINTENDENT, EVERGLADES NATIONAL PARK

Mr. CREEL. Thank you. Good afternoon, Mr. Chairman.

Perhaps I can give you a little bit of background. I was Assistant Director of Civil Works for the Corps for a number of years and covered from Buffalo to Montana, covering Minnesota, and I think I took Mr. Stangeland on a trip one time, as a matter of fact, while I was Assistant Director of Civil Works. I also then was District Engineer in Savannah, GA, and then I was the Director of WES, Waterways Experiment Station, before I became the Deputy Director of the South Florida Water Management District 4 years ago, almost 4 years ago.

Mr. NOWAK. That is when you went to work.

Mr. CREEL. Well I hope I did some work before that, sir. [Laughter.]

I would like to enter my remarks into the record if I could and perhaps summarizing would be more helpful to you.

Mr. NOWAK. Your total remarks will of course be accepted into the record as well as the other two witnesses.

Mr. CREEL. Governor Martinez and Secretary of DER, Department of Environmental Regulation, Dale Twachtmann asked me also to represent them in this testimony. I have not cleared my testimony with them but I believe it is not in conflict with the State's position on these matters.

We are pleased to have the opportunity to talk about the water management system in Florida. We are one of five Water Management Districts. We are the largest, with about 1,250 employed at the Water Management District, and with coverage of an area three times the size of Connecticut. We go from Orlando all the way to the Keys, so it is a very large area and basically is the Kissimmee River/Lake Okeechobee/Everglades system. It is an old system in need of repair and most of my testimony at the end will talk about the aging system. It is like a middle-aged person, a system that was put together some 40 to 50 years ago—we will be 40 years old next year—and many of the things that were basically done for flood protection and water supply have deteriorated as with any system 40 years old. So we will talk about the infrastructure if we can, as well.

Many of the previous members talked about 1,400 miles of canals and levees carrying the waters away from populated areas and farms to prevent flooding, and carrying water to recharge areas during times of drought. These canals were basically built as agricultural canals and now, because of the increase in population in Florida, are having to serve an urban population that is growing daily. Palm Beach County alone gets 100 new people every day.

Three water conservation areas, located west of Dade, Broward and Palm Beach Counties, span an area of some 1,300 square miles. I think you saw them when you flew over today. The Water Conservation areas are ringed by levees which allow water levels to be controlled. This allows retention of water from the canal system, alleviating loss of water which otherwise would have been discharged to the sea. The conservation areas also protect the water supply by recharging underlying aquifers.

The multipurpose water management system has been operationally modified to provide environmental benefits. Some of the benefits, which previous members also discussed—previous speakers, include water releases to Everglades National Park which are based upon rainfall. We believe these releases, in the long-run, are essential to preserving the park and making it back hopefully to where it was 20, 30, 40 or hopefully even 100 years ago. It perhaps would closely mimic nature and then also into the estuaries because we have to move water into the Caloosahatchee River and the St. Lucie, moving it east and west, you have to be careful of the kinds of releases that you make, so you do not upset the delicate balance of salt water, fresh water interface in the estuary and destroy the fish life in that area. So we hope that the pulsed releases that we make, that that will not harm the marine ecosystem.

A glimpse of water quantity and water quality issues within the system provide a better understanding of these components.

Starting at the top of the system with the Kissimmee River, let me describe the importance of the river to the lake from a water quantity standpoint. Second only to rainfall—rainfall provides 40 percent of the water for Lake Okeechobee. I think Lou DuCret talked about the fact that we get some 55 to 65 inches of rain in south Florida, so heavy amounts during the months of June, July, August and September—our wet season—normally provide 40 percent of the water to the lake. About 30 percent or so comes down

the Kissimmee River. And so you can see the Kissimmee River is extremely vital and the water coming in there vital to the lake.

Moving farther south, the lake itself serves as a direct water supply for six public water supply utilities around the lake, the small communities around the lake, and serves as a backup supply for the residents of the lower east coast during times of drought. Certainly lower Palm Beach County, Broward and Dade and the water supply for Monroe County and Key West would not be possible in many cases without these canals available to backup the aquifers. The lake was tapped five out of the past 18 years to supply water directly to wellfields along the lower east coast during times of severe drought. And during eleven of the 18 years, water from the conservation areas were used to maintain adequate amounts of fresh water in the coastal canals in order to discourage salt water from reaching drinking water wells, and to help recharge the overall water table.

Further downstream is the Everglades National Park. While the park does not receive water directly from the lake, its major source of surface water comes from the southernmost water conservation area, Water Conservation Area 3 as we call it. Releases into the park are based on current water conditions in the water conservation area, the so-called rain driven model. This provides more natural sheetflow across the 80-square mile wetland Shark River Slough area east of the park. We hope we can acquire some 75,000 acres of land there to allow this modification to go forward, and also reduce the incidence of dramatic changes in the flow rate.

Water quality; the District is concerned about the quality of water flowing through the entire K-O-E system, primarily from the standpoint of the effect changes in water quality have on the environment.

The primary goal of the restoration of the Kissimmee River is to enhance fish and wildlife habitat. Cleansing of the water would be a secondary benefit.

Although water quality problems in Lake Okeechobee are threats to the fish and wildlife and recreational uses of the lake—I might add, and Mr. Stangeland talked about it I think very well—Lake Okeechobee is a marvelous lake for fishing. There are other problems with it, but it is an excellent lake for fishing. So although water quality problems in Lake Okeechobee are threats to the fish and wildlife and recreational uses of the lake, these problems, caused by an increase in nutrients such as phosphorus and nitrogen, may not necessarily present a dangerous threat to the water supply. The lake as a drinking water supply would not be rendered unusable should the health of the lake continue to decline. The primary effect would be a potential increase in water treatment costs and the loss of the fisheries.

Water quality problems resulting from runoff sent from the Everglades Agricultural Area south of the lake to the water conservation areas present a threat to these areas. Nearly all of the water from the EAA, 98 percent, was sent to the water conservation areas last year, rather than to the lake. This is because the District is prohibited from sending water to Lake Okeechobee from the EAA during floods, except under extreme drought conditions—I am sorry, extreme flood conditions, in an effort to reduce nutrients

reaching Lake Okeechobee. So that was very much an effort on our part to reduce the amount of nitrogen and phosphorus going into the lake and hopefully to reach the 40 percent reduction in phosphorus. The water conservation areas are experiencing changes in vegetation which do not provide optimal fish and wildlife benefits.

Obviously if you take the water south, you are going to increase the number of cattails and you are going to increase the effect on the park farther down, and you are going to have an increase in the effect on the estuaries.

The district is pursuing recommendations of two state technical committees. The previous speakers spoke of reports of LOTAC I and LOTAC II—Lake Okeechobee Technical Committee (LOTAC I) and the Lake Okeechobee Technical Advisory Council (LOTAC II). I would be very happy to provide the Committee with both of those reports, and other technical manuals that we have concerning cattail growth. These technical committees were formed during the last three years to address the lake's water quality problems and resultant downstream impacts to the water conservation areas and estuaries.

While the district is pursuing Federal funding for the Kissimmee restoration project, this agency has a significant ability to levy ad valorem taxes to generate funds for many of the environmental restoration projects which do not qualify for Federal cost-sharing by the Corps and which the State has not funded through general revenue.

Our budget this year that we are in is $144 million and expected to increase this next year.

I would like to now turn to infrastructure needs. In addition to the environmental projects, the District is going ahead with improvements to the infrastructure of the water management system. We are paying our way on projects which we do not think can wait for the Corps planning process or for which the Corps has not contributed funds.

I would like now to focus the remainder of my testimony on the infrastructure issue, an issue which we consider significant to the safety and welfare of south Florida.

The Central and Southern Florida Flood Control Project is 40 years old and in need of repair and modification. The design life of many of the older projects in the system is 50 years. Many of the older structures need to be replaced and much of the system, because of urbanization, needs to be revamped. A number of the canals were anticipated to always be agricultural, never urban. And we are seeing that change dramatically. Certainly Broward County is one and the Hillsboro area specifically.

The original design of the system may not be enough to provide an adequate level of flood protection if a wet hurricane hits south Florida and drops 10 to 20 inches of rain. Coastal locks and dams, as they stand today, may not be able to restrain the sea water in a serious storm. Polluted drinking water could be the result. South Florida has not experienced such a hurricane in many years, and forecasters warn that the pattern could change. I think 28 years ago in 1960, Hurricane Donna was perhaps the last major hurricane in south Florida. I was not present in this state at that time, but I did go through a hurricane in Savannah with Hurricane

David and I do know the effects of it and that was a minor hurricane.

A prime example of where infrastructure has not kept pace with growth is a 64,000-acre canal basin in Palm Beach County known as the C–51 basin. Population has already reached 30,000. This population level was projected in the 1950's to occur in the year 2040. According to today's estimates, the population will reach 150,000 by 2040.

It is going to be expensive to repair the system. The total tab for refurbishing the entire 40-year-old south Florida water management system is estimated at $120 million. Some $500 million was put into building the original system, and if that system were to be built today, it would cost between $1.5 and $2 billion.

The South Florida Water Management District has made a commitment to accept the responsibility of paying for the majority of the improvements. The District is only at half its millage rate and plans to double its construction budget from this fiscal year to the next, some $20 to $40 million, and to triple it within the next 5 years.

However, the district is exploring the effects of the new Water Resources Development Act and I certainly would like to compliment the Congress on that act. That was (certainly) a major step forward. I testified in the last act before that, in 1976, so we are very pleased to see that act come forward. We see the opportunity to establish a new partnership with the Corps and pursue Federal participation in some cases. With the construction tab as large as it is, and because we have a cap on our millage rate, additional outside funding sources will still be needed in the long-term to supplement the district's effort. We are aware of the increase in public works funds and we plan to fully explore our options.

One way or another, the District is committed to ensuring that the system functions properly. The welfare of the people in south Florida, and the integrity of the K–O–E system depend on it.

I will be very glad to answer questions.

Mr. NOWAK. Thank you very much, Mr. Creel.

Let us hear from our local government representatives here first. Mr. Roy Reynolds.

Mr. REYNOLDS. Thank you, Mr. Chairman and members of the Subcommittee. My name is Roy Reynolds, I am the Director of the Broward County Water Resources Management Division. I have worked in the water resources field in south Florida as an engineer and in management for about 17 years now. During that time, I have had an opportunity to see how the various organizations from the Federal level to the State level to the local level interact.

During this brief interview of the testimony I submitted previously, I will try to give you my opinions on that interaction and some of the areas that we might be able to improve them.

I think from the previous testimony you may have realized that our water resources system is vast, extending all the way from Orlando, as Mr. Creel said, through the Keys. It is complex, it is difficult to explain in a short report.

I think I can condense most of those complex requirements into one statement that is fairly easy to understand and one that you have probably heard many times before. That is nothing but "send

money please". But assuming that you do not have trucks full of money available for us, I will cover some of the issues that we have here in southeast Florida.

Beginning, I think we have to realize that we are dependent upon ground water for our drinking water. You have heard our aquifer systems mentioned and I believe that Mr. Stangeland mentioned the saltwater intrusion problem that we are having in our aquifers that we are working on. All the water that we drink here in south Florida, in Broward County and in Dade County and in much of Palm Beach County, comes from rainfall from as far away as Orlando, and it is the Central and Southern Florida Project that brings us much of our water. Mr. Creel just mentioned that over the last several years there have been several instances when water had to be brought in from as far away as Lake Okeechobee where it is stored. Water is also stored in the conservation areas, which are a part of the system. Some 800 square miles of Broward County's 1200 squares miles have been set aside as conservation areas, with the remaining 400 square miles being the developable coastal or eastern portion of Broward County.

Unfortunately, as I have said, the aquifers have come under great stress. And the stress has been not only by the population and growth in our population, but by the vagaries of nature. As a result, we have had to develop management methods that would have been impossible without federal assistance. That assistance has come to us in the form of the vast Central and Southern Florida Project of the Army Corps of Engineers, and it provides the circulating system through which our lifeblood, the water, flows. It both recharges our aquifers, carries away our wastes at times and moves our flood waters to the ocean.

We have also received assistance in data gathering in studies from cooperative programs with the USGS. The 201 and 208 programs of the EPA have helped us provide good sewerage treatment and again to clean our surface waters. The EPA's designation of the Biscayne Aquifer as a sole source aquifer has raised the awareness of its importance and helped to establish an atmosphere in which our wellfield protection program and water supply program could achieve acceptance.

But even with all of these accomplishments, our jobs are not nearly complete. Active studies of the changing role of the Central and Southern Florida Project from one of flood control, which it was primarily up until the 1960's, to a complete water resources management system that encompasses flood control, water supply and conservation, will lead to decisions that will have a profound effect on all of southeast Florida.

The Central and Southern Florida Project is a vital part of our water supply program, which is why we requested the study to determine its future ability to deliver recharge water to our aquifers. That study has been approved in Congress as part of the public works appropriations. However, it has not been funded, and for the last 2 years has merely sat on the approved projects list.

Broward County is committed to providing a long-term water supply system that will stop saltwater intrusion and meet the demands of a population that is projected to double over the next 32 years. But we must now know how much water for aquifer re-

charge we can expect from the project. In addition, we must be certain that future decisions on the project's operation are made with an awareness that it must now serve as a multipurpose water management system and not as a single-purpose project.

Fortunately the relationship between federal, state and local organizations has been very good in Broward County and much as been accomplished. However, there will be an ever greater need for that close cooperation in the future as a growing population exerts even greater demands on the natural and manmade systems, we need to better understand how to protect our ground water from the contamination of our every day activities. We need to develop better management methods that recognize that storm water, waste water, surface water and ground water are not separate entities but are only stages of one resource.

And of course, we need a realization in Washington and Tallahassee that all of the infrastructure dollars built—or spent, excuse me—on building roads and sewerage treatment will diminish greatly in value if we do not receive the assistance necessary to provide an adequate infrastructure for drinking water.

Perhaps the gist of what I have said is that we, the residents of Broward and our neighboring counties, are a part of the ecosystem that has been discussed here today; that we and the rest of the ecosystem are inter-dependent; and that the future water resource decisions should be made with full knowledge of that inter-dependence.

I thank the chairman and members of the subcommittee for this opportunity to address you and welcome any questions that you may wish to ask later.

Mr. NOWAK. Thank you very much, Mr. Reynolds.

Before we ask questions, let us have the testimony of Doug Yoder, who is the Assistant Director for the Dade County Division of Environmental Resource Management.

Mr. YODER. Thank you, Mr. Chairman. I am pleased to be here and I bring greetings from Mayor Steven Clark, the mayor of Metropolitan Dade County and his colleagues on the County Commission. You have my statement also I believe.

Mr. NOWAK. That will be incorporated in the record.

Mr. YODER. Let me just summarize a few issues that perhaps illustrate to some extent the responsibilities of local government in this whole complex issue. I speak as somebody who is more or less at the end of the pipeline of this whole system, Dade County is at the end of the river of grass, as it has been called. And so we sometimes get what is left over after it has been through the rest of the system. I guess if there was someone here from Monroe County, Key West, who are literally at the end of the pipeline which starts in Dade County and ends in Key West, they do get their water from wellfields located in Dade County.

Land use control I think is probably the key responsibility that local governments exercise with respect to water resources. And obviously land use controls have direct implications in terms of water supply needs and also in terms of water quality.

Dade County, as you may know, is flanked on one side by the Everglades National Park and on the other side, on the east side, by Biscayne National Park, making it one of the unique counties in

the country in that regard. And it gives us perhaps a special responsibility with respect to the stewardship of our natural resources, more so than perhaps some other localities may have.

I want to just relate briefly a couple of examples of things that have happened in Dade County that I think are success stories with respect to fulfilling those local responsibilities. You have heard mention of the east Everglades. The east Everglades is an area of about 260 square miles which up until about 8 or 9 years ago was virtually entirely in private ownership. It is adjacent to the eastern boundary of Everglades National Park and lies south of the water conservation areas that are managed by the Water Management District. It is part of the undrained area of Dade County. That is to say it lies to the west of the floor control system which has made possible the rather intensive development in the eastern part of Dade County. So it is an area that is still largely a wetland area.

In the middle 1970's, it became apparent that there was a lot of pressure to develop the east Everglades area and in fact it is the area that probably best typifies some of the kind of land speculation that Florida at one time or another has been famous or infamous for. A lot of the land was sold off to unsuspecting people in other parts of the country without them realizing that for 9 or 12 months out of the year, it was under water.

Well as the development pressure in that area increased, it became apparent that in the interest of protecting not only the resources of Everglades National Park but also our urban water supply recharge areas, it was going to be important to have some additional controls for that area. After a couple of years of study, which was financed in part by the Environmental Protection Agency, which I think demonstrated very well a cooperative effort of state, federal and local governments, a plan was developed. And the key to that plan was land use control in the form of changing the zoning such that it required 40 acres to build a house whereas some of the existing parcels out there were as small as an acre and a quarter. And you can imagine, particularly if you have had experience as a local government official, the political difficulties perhaps of making that kind of a change with respect to how property owners could use their property.

Nevertheless that was done and I think has made a very substantial difference with respect to how development in that area has proceeded.

Another area in which we have been very active since the late 1970's is the area of wellfield protection. Mr. Reynolds mentioned a program, I think the representative from EPA mentioned a couple of other programs here in the south Florida area. We have the first wellfield protection program of its type in the nation, which regulates land use as a function of its proximity to wellfields. And regulates very, very rigorously. With respect to our program, if you want to undertake anything other than a residential land use, you cannot do anything that involves use or storage of hazardous materials, you cannot build a gas station, you cannot operate a dry cleaning facility, a whole variety of things that create a good bit of inconvenience but also I think will ultimately protect our wellfields over the long term.

Those are the kinds of things that I think local governments are in a position to do that fulfill their part of the responsibilities in this water management equation. I have indicated some specific suggestions in the conclusion of my testimony. We certainly support very strongly the ongoing work the Corps of Engineers and the Water Management District and the Everglades National Park are doing with respect to the general design memorandum that will perhaps result in reflooding the northeast Shark Slough, which is in the east Everglades, and will restore the historic waterflows to the park which we see of course as being beneficial to the park but also is important to the recharge system for the Biscayne Aquifer. We certainly support acquisition of the east Everglades, which is the ultimate land use control, something which really was not within the financial capability of the county at the time that the east Everglades study was done.

We clearly support continued Federal involvement in this whole system and I think Mr. Creel has indicated the importance of looking at that infrastructure and I think taking note of the fact that it is a changing—there are changing demands on the system, certainly from flood control to water management, considerations of urban water supply needs versus agricultural needs versus needs of the Everglades National Park.

There is I think without question a continuing federal role in the area of applied research, development of best management practices that we know will work, a lot of continued need for research for setting water quality standards, which in many cases we end up enforcing. The federal wellhead protection program has been mentioned here. One of the problems that I think federal agencies have that sometimes trickle down to us is that there are mandates that are created by wise congressional actions and for which the appropriations are not forthcoming. The wellhead program is one of those, and I am sure you are very familiar with those problems.

Finally, I would mention the area of agricultural management, which has been previously discussed. We, ourselves, are now in the process of implementing an agricultural management program, just at the beginnings, primarily for the purpose of protecting groundwater from the effects of pesticides and possibly fertilizers. It is an area in which the Environmental Protection Agency has been active, but again I think that is a problem of national concern, it is a problem for national debate at this time.

In closing, I guess I can observe that Dade County, being perhaps the most intensely developed of the south Florida counties, has experienced some of the problems already that are now appearing in Broward County. And hopefully they may learn from our experience. The salt intrusion problem hit us some years ago and has been largely resolved by putting controls on the canal system so that we do not get saltwater coming up the canals; and secondly, moving the wellfields to the west. We are fortunate at this point to have a regional water supply authority that ultimately is going to have a series of wellfields to the west of the developed area so that they can adequately protect it from urban development, and—but still far enough east so that they are not significantly interfering with the natural water system that is sustaining everybody's national park.

Thank you, Mr. Chairman.

Mr. NOWAK. Thank you very much. Thank all three of you for very fine statements. I had—well, let me take care of a couple of things I should have done before.

Also, is Mr. Finley still here?

Mr. FINLEY. Yes.

Mr. NOWAK. Mr. Finley, I am sorry, I wanted to ask you earlier about this 40 percent cure. In relation to what you are seeing as Superintendent of the National Park, I wonder what, first of all, effects you have been seeing with the increased nutrients that you are receiving and if you have an opinion, reviewing as I assume you did, the technical reports, if that 40 percent figure is a relatively helpful number in completely solving the problem.

Mr. FINLEY. OK, Mr. Chairman, I would be glad to answer that. For the record, my name is Michael Finley, Superintendent of the Everglades National Park.

If I might, I would like to use this as an aid. The question is well taken. First of all, let me preface this by saying that in 1934 Congress charged the National Park Service with preserving Everglades National Park, as you would do with all national parks, but in our case you require that we shall preserve intact the unique flora and fauna and the primitive, essential, natural condition; so those are our management goals as prescribed by the Congress.

So then when you asked what happened—and you have all flown over part of the Everglades this morning I understand. I am sorry that you were not on the ground to see some of the detail that you missed from the air. It looks rather monotonous from the air, but really there are pine forests, Florida panthers, crocodiles, alligators and a number of wading birds. Unfortunately those wading birds have decreased by 90 percent in the last few years. In December, I was informed by National Audubon scientists that the roseate spoonbills that nest in Florida Bay have decreased by 50 percent, crashed in population, since 1980. So our resources are in serious, serious decline in the Everglades, and when you asked about water quality and the 40 percent target, I have to say it depends on how our water is delivered. But in general 40 percent is totally inadequate to prevent deterioration.

There are a couple of ways that water can be delivered. Obviously this is the park, you can see the historical flow right through the park to the mangrove estuaries and the park encompasses this much of Florida Bay, about 400,000 acres. So when we talk about Everglades National Park, we are talking about the wetlands, the uplands and Florida Bay.

If the water is delivered from Lake Okeechobee through the canals into the water conservation areas and it percolates through there, the vegetative acts as a sponge, nutrients are soaked up and the nutrients we receive then in the park are very low, very few in number—except for nitrate now. We are getting levels of nitrate from—into particularly S-12(d) structure, which means is right here, one of the structures that delivers water into the park, in excess of our agreed upon standards with the Corps and with the Water Management District.

If, however, the water comes down these canals, and it is much like getting a shot at the doctor's office—if you get it intramuscu-

lar, it takes awhile to work its way into your system. If we get our water IM or through the water conservation areas, which by public policy we are sacrificing them to preserve the park from these heavily nutrient laden waters, then the water is cleaned up pretty much by the time it gets to us.

If in fact though it is shunted down the Miami Canal to here and down the L–67's to here, and dumped into the corner of the park, it is like an IV, it is a full dose. So whatever is in those canals is delivered to us.

Mr. NOWAK. What portion of your water comes in either way? Do you have any figure on that?

Mr. FINLEY. Well when it comes down Shark River Slough—we are guaranteed 315,000 acre feet a year by an act of Congress. Two hundred sixty thousand acre feet come through here and 100 percent of it almost comes through these S–12's although under a bill introduced by Mr. Fascell and enacted by the Congress during the last 3 years we have moved this water a little eastward, so instead of getting 100 percent through this gap here, we have moved it over into the Shark River Slough, which you flew over this morning.

So our concerns are that there is a tremendous, tremendous volume of nutrients to our north. And so what we did—and I will stop in just a minute, Mr. Chairman, but where you flew over this morning, Shark River Slough, that is virgin Everglades. So then you say well in the virgin Everglades, what is the dosage that would cause some sort of damage or disrupt that ecosystem and result in a break in the charge that Congress gave the National Park Service. So we dosed that virgin Everglades and here is a schematic chart. This down here is Everglades National Park, up here is Lake Okeechobee. You can see the water received through these structures, so you ask yourself if we build a structure 100 meters long in the middle of the virgin Everglades, what is the result of receiving this nutrient laden water, what is the background level of say phosphates. So we dosed phosphate. The background in the Everglades National Park marsh is four parts per billion; very, very low nutrient natural levels. In Lake Okeechobee, it is 100 parts per billion.

Well that is not the total answer to the question because in between the 100 parts per billion here and the four parts per billion in the park, the canals in the EAA have 355 parts per billion. Now these are South Florida Water Management District statistics—figures. So it picks up through those canals, there is a tremendous impact there. Even if Lake Okeechobee were "clean," we would have a serious problem remaining in the Everglades Agricultural Area.

The same for nitrate, nitrate background levels in the park are 10 parts per billion, in these canals up to 2700 parts per billion. OK, so then you would ask us, you would say you have ten parts per billion in the park, your natural level of nitrate, but four parts per billion of phosphate, background level. You have these extremely high numbers above the park, where do we find damage. We dosed it, we built these fiberglass 100 meter long dosing stations and we dosed it for 12 to 18 months. What we saw when we dosed at 33 parts per billion—remember the lake has 100 and the

canals have 355, we dosed at 33, natural level is four—we saw damage. We saw that natural algal level destroyed. And I was out there last December and it is yet to come back since 1982 in the phosphate dosing channel. We dosed phosphate only in one channel, phosphate/nitrate in another one and nitrate singularly in the other. So we had damage. We had sawgrass replaced by cattails. Well sure, that violates Federal law and your direction to the National Park Service. Congress provided we manage and protect it and directed the Corps to deliver us water that is of sufficient purity not to degrade the environment. But it goes beyond that.

As you said, Mr. Stangeland, a lot of cattails and you lose your dissolved oxygen, you lose your fish, you lose your small fish, you lose your wading birds. Our wading birds have crashed 90 percent. It is not just water quality, it is water quantity and loss of wetlands. The same with the nitrate.

And I will not go on any further, Mr. Chairman, but these are the types of things that we would be happy to provide for the committee, the record of this dosing study and some of our other concerns into the real threat that is holding over our head. And we believe that it is immediate and it may be terminal for some of our species. We have 11 of those endangered species described. In summary, 40 percent reduction in nutrients is totally inadequate. We read at least a reduction to nutrient levels lower than the levels we dated and documented damage.

Thank you.

Mr. NOWAK. Thank you very much, Mr. Finley, I appreciate that. Certainly we want to look at the records that you have derived from those various loadings that you have, as you say, dosed.

Let me turn—Mr. Creel, could you tell us how are you procedurally or structurally associated with the State. The Commission has elected you or appointed you as Deputy Executive Director? Who appoints you?

Mr. CREEL. It is very interesting, Mr. Chairman——

Mr. NOWAK. South Florida Management District.

Mr. CREEL. Mr. Chairman, we are an agency of the State, we are not a State agency. And that was set up by the State legislature in which the nine member—it is a significant difference—the nine governing board members are appointed by the Governor and confirmed by the State Senate. The Governing Board selects the Executive Director, Mr. John Wedraska is our Executive Director. He and I came on board about the same time, he had been the Deputy Executive Director before that. He then appoints the staff, they are selected by him and confirmed by the governing board—senior management staff is.

We are actually financed by ad valorem taxes from the 16 counties we serve. And we receive some State dollars in some programs that are mandated by the State and some money is appropriated by the State, but by and large our moneys come from our taxpayers in the District—the 16 counties we serve.

Mr. NOWAK. The statements of these loadings, it seems to me too that the State and your position and your institution does not have the full control over these decisions that are going to start to make a difference as we go along, although I am sure they are going to

go to your organization for advice as to what can be done and the consequences if some action is not taken.

We have heard from EPA that they cannot at the present time control these types of decisions for nonpoint sources of pollution, but after reviewing your infrastructure problems, which I think not only are flood control but really water quality control too, I think if you get breaches in your system, that is certainly going to add to the problem.

One factor with these loadings that are in the system and much higher I guess nearer to Lake Okeechobee than they are away from the lake—Mr. Findley said as they drain south they get lighter—I wonder if you could visualize all of those loadings in the future that are heavier up north moving south in any increased way.

Mr. CREEL. Mr. Chairman, we are very concerned about it, and I think Mr. Finley has said very clearly, the kind of research that the National Park did indicated from a research point of view in a narrow sort of area there what effects there were. We are concerned about it and have actual details. When you start moving that water out of the Everglades agricultural area, we are talking about 350,000 acres moving south into the conservation—areas Conservation Area 3, the northern part of it, and Conservation Area 2 as well, have been taken over by cattails. We have some very significant information in our technical reports, which tell you based upon this estimate what we think, how long they are going to take over. We cannot tell you that the nutrients will move all the way through in 5 years, 10 years or 50 years. But if it is not changed over a period of time there is no question that the sawgrass, which has an opportunity and does take up the nutrients much better than the cattails, will disappear and the sawgrass marsh will in fact probably leave over a period of time if you do not change the way you are putting that water in—or do not clean it up in some way. I think one of the earlier members of the Committee was commenting about what are we doing to try to clean it up both from the agricultural areas themselves and from the dairies in the north.

The dairies in the north, we believe, are the most significant problem. Certainly the sugar cane fields to the south of the lake are important, but the dairies in the north, the phosphorus, at least on the basis of the Technical Committee—this is the Lake Okeechobee Technical Committee Report (LOTAC I)—believe that we have got to clean up the phosphorus and that is the most significant thing before the nitrogen. We have got an awful lot of it. We are in a subtropical region and therefore it is much more difficult than say cleaning up Lake Erie in many ways, though we do not have the heavy metals and the problems that Lake Erie had. But we do have a subtropical area and it is very difficult to clean it up because you do not get the freezes down here and you do not have some of the same ways of cleaning it up as in the north.

We are looking at, for example, the dairies first. There is something in excess of 50,000 cows, and it is like having a city perhaps of 100,000 without a sewage treatment plant. You can just imagine what that would do, putting it into the creeks and areas that we are talking about. Right now, we are trying a model dairy in which we are putting a package treatment plant actually on this dairy

itself to see what effect that will have, what the water will be in the treatment ponds, and then we will actually put that cleaner water into Taylor Creek and Nubbin Slough. We are also trying out a research program this year that is going to cost us over a million dollars called aquifer storage and recovery, of actually taking this untreated water and taking it down into the aquifer itself, holding it there hoping it will treat itself on the way down, then bringing it back, into Lake Okeechobee, so you do not lose the long-term water from the water supply.

We also thought about a reservoir. We have not turned that down; the Corps is studying it right now, the possibility of putting a reservoir, pumping the polluted water out of Taylor Creek and Nubbin Slough, putting that water into this reservoir, holding it, treating it and then discharging it into tidewater or taking it back if it is treated, back into Lake Okeechobee.

The concern there is that if you take that water and put it into the canals in the north, you are then transferring the problem to the estuaries, and that certainly is not our intent.

South of the lake, we are looking at right now running a series of treatments in areas of the State-owned lands, and we would go ahead and try very hard to find out what the uptake (of nutrients) in plants is. And so before we ever take that water south into the conservation areas and finally into the park—and I certainly agree with the Superintendent there is a serious problem—then we will find out whether we have to hold that water there and treat it before we ever move it south.

There are the kinds of things that are coming out of these Technical Committees, the kinds of reports. We are talking about significant dollars over a period of time to clean up Lake Okeechobee and the Everglades agricultural area.

Mr. NOWAK. One other question if I may. We are going to run out of time here, but let me just get a clarification. Perhaps Mr. Reynolds, you could answer this. What is the—as this phosphorus moves up and you receive that water to treat it for drinking supply, what is the increased cost or concern you have as these levels go from 355 parts per billion to whatever they will be in the future?

Mr. REYNOLDS. We have not yet seen that as a problem in our water treatment systems. I am sure that if it has not gotten——

Mr. NOWAK. Do people grow faster if you——

Mr. REYNOLDS. We seem to grow people faster, we certainly are increasing the numbers. Maybe that is part of our problem and we did not realize it.

Mr. NOWAK. It is not the weather, it is the water.

Mr. REYNOLDS. It could be. As yet, we have not seen that as a problem. I am sure that if the levels continue to grow and if we were to have the levels of phosphates and nitrates in our canals that we use to recharge the aquifer from the conservation area, that they are seeing up in the southern portion of the area south of Lake Okeechobee, that we would definitely have a problem.

Some of the water is cleaned just by moving it through the aquifer; however, I do not think if we had those levels, 2,000——

Mr. NOWAK. Is my understanding right that your aquifers are approximately 100 feet?

Mr. REYNOLDS. No, sir, in the eastern part of the county the aquifer is as much as 500 feet in depth and thins out to less than 200 feet in the western part of the county. Most of our wells are in the range of 100 to 150 feet in depth where we find the best producing areas.

While I am speaking, if I may just a second—I happily misspoke myself giving my testimony. After I said it, the Corps of Engineers passed me a note that says that they received $100,000 to initiate the Broward County study as to how the Central and Southern Florida system will interact with our water supply system and that that water—rather that money just arrived in the District. So quite happily, I misspoke myself to you.

Mr. STANGELAND. Mr. Shaw brought it down with him.

Mr. REYNOLDS. Oh, thank you. I should have known.

Mr. NOWAK. Well we are getting started anyway. The last thing, let me just comment I think Mr. Yoder gave us some very astute testimony. We have got to look at this as a partnership. You know, we are struggling with many of these things that perhaps we did not realize—there was no state of the art 25 years ago and we are feeling it up north at many Superfund sites and of course you are feeling it here today in increased concern, of actions that were taken without regard, perhaps without knowledge at the time, and now we are getting some very heavy impacts in the payments now that are going to be necessary to clean up or correct these situations, which as in Superfund, are astronomical. And you know, we are trying to get to the stage—not that we have to place a ton of money for "program cleanups" but trying now to focus on what can we do to prevent the actual pollution from coming into the environment on the front end. Even if that is costly at the present time, we must develop some kind of incentives so the chemical companies or the producers will have incentive to look at a broad range of research projects to stop even producing harmful materials, so we do not have landfills or we do not have the kinds of chemicals that are causing this problem. I will almost guarantee in a few years you are going to find a completely different type of farm management in this area, so that those will not—the chemical companies will stop producing the harmful types of fertilizers that they are producing today. In fact, Monsanto I know is spending an awful lot of money changing their whole system around so that they are not putting initially into the environment anything that local officials and state officials will then have to clean up.

And we are all struggling for the answers and the taxpayers are paying. Which brings me to your point of land use controls, which really you know, is another way of saying let us prevent instead of saying go ahead and then at the end try to find the dollars to clean up, which is going to be enormously expensive and maybe we are just on the tip of this iceberg. Unless the state cooperates and, you know, the owners of those farms.

I did not see from that airplane an awful lot of very small farms that you are dealing with. You know, 400,000 people with an acre and a half farm as we have in western New York.

Mr. CREEL. They are not family farms.

Mr. NOWAK. These farms seem to me to be somewhat isolated. You know, I do not know if they have airplanes to get to these

farms, but they look like huge spreads that some, I am sure, corporate farmer has put together and maybe it is the only way to make a profit, but by the same token they owe even a greater degree of responsibility to act as a good corporate citizen.

I hope we can focus on that and the local government officials and the state can look at that as a way to reduce our kinds of contributions. You know, you talked about money, Mr. Reynolds, but money—the criticism that we are receiving from the states is that we spend too much money. So you know, as we look at our budget problems and try to solve all of these problems at the same time, unless we get innovative and stop some of the causation of the problems, we are going to be in a circle running around chasing each other.

Let me go to Mr. Stangeland.

Mr. STANGELAND. Thank you, Mr. Chairman. I am going to be very brief. I want to thank this panel very much because I think they have given some excellent testimony. And I would ask unanimous consent, Mr. Chairman, if I might be allowed to send out written questions not only to this panel but to the panel that preceded it, because I have some questions that I did not get to ask and in the essence of time I thing we can get the information that way.

I have one point that I would like to clear up a little bit. It has to do with the map that Mr. Finley was showing. The water conservation areas are separate and apart from the Everglades agricultural area and from the Everglades National Park, are they not?

Mr. CREEL. Yes, sir.

Mr. STANGELAND. And the water conservation areas are sawgrass areas primarily?

Mr. CREEL. They are tree islands and basically sawgrass. They do have unfortunately malaleuca in some areas—and now unfortunately more cattails—as well.

Mr. STANGELAND. So they could not act as an artificial wetland for the purpose of being cleansing mechanisms?

Mr. CREEL. That is exactly one of their main purposes. They act as a cleansing agent. The water comes into them, it is taken up by the various plants and then the water goes into the deep aquifers themselves and by the time it gets to these gentlemen here, it is very fine water unless it has been contaminated by gasoline or something else.

Mr. STANGELAND. And this is generally why the loadings are much heavier in the canals and the lake as opposed to what ends up in the Everglades Park itself? But they still are not doing the whole job?

Mr. CREEL. No, no, they are doing a relatively good job. What Mike Finley was talking about, sir, is if the water comes directly into the canals, pumped into the canals and then goes straight down—in other words, if the water is allowed to flow overland, which we hope to do and we have bought some areas south—actually north of the conservation area, if I could just show you, called the Holy Land restoration area, and the Rottenberger areas and these particular areas here, will be set up as areas—not the same as conservation areas but in fact will act as cleansing areas in many ways. They will be filled with 2 to 3 feet of water perhaps,

flow the water through there and when it gets to the conservation area, it is already cleaned up a little more.

The alternative of course, the best alternative, is to store the water on the Everglades agricultural areas themselves, but that obviously takes land out of production which the farmers are not very willing to do.

Mr. STANGELAND. Is there any amount of new land going into production in this whole area now, at this time?

Mr. CREEL. I would say probably not. I would say if anything the state has a very active program, certainly we have, of turning this land back to natural everglades rather than going into agricultural production. The same way north of the lake in the dairy farming areas themselves, we are taking a hard line as far as they are going to have to put these best management practices in place or we are going to put them under permits, complete permit.

Mr. STANGELAND. Just one last comment to this panel. It seems to me that when you are dealing with dairy farmers and cattle grazing out on a range, you have a bit of a problem in land management, in finding the best management practices, and it is something that has to be looked at.

Thank you very much, Mr. Chairman.

Mr. NOWAK. Congressman Shaw.

Mr. SHAW. Mr. Creel, I would invite you or Mr. Finley to correct me if I misunderstood, but I sense that there is a disagreement between the two of you as to the extent of the source of pollution south of the lake. If I understood Mr. Finley correctly, the nutrient being picked up south of the lake coming through the canals is rather substantial. And you seem to negate that and say that it was mainly coming from the top. Is that something we can find simply by taking a water sample?

Mr. CREEL. I would disagree with Mr. Finley from the perspective that what Mike has pretty well laid out is a theoretical type of problem which was done under test cases. What we do is we have water quality monitoring at all of the stations that flow into the Everglades National Park in which we pick up—and we have agreements between the Corps, the Park and ourselves which clearly lay out standards, and if they exceed those standards, they are reported. And we have technical meetings, how often, Mike—probably we meet with your folks quarterly, monthly and what we lay out very specifically there, if we exceed those annualized standards, those are laid out very carefully and we try to clean them up. But they have been minor.

Mr. SHAW. The South Florida Management District, the appointments by the Governor, are they not mainly agricultural people?

Mr. CREEL. No, sir.

Mr. SHAW. Or landowners?

Mr. CREEL. No, I would say the Governor has an excellent balance. Both Governor Graham in my view and Governor Martinez have had excellent balance.

Mr. SHAW. What is that balance? I am not making that charge because I frankly do not know who is on there.

Mr. CREEL. Well the balance right now—during Governor Martinez' appointments—I would say you have more agricultural than you had under Governor Graham. We have a lawyer from Broward

County who work with a land development company, she is chairman of the board, Chairman Nancy Roen. And then you have from Dade County Mr. Arsenio Milian who is a utilities manager for the Deltona Corp., and Mr. Doran Jason who is a real estate developer. You have Orlando from Windermore, a gentleman who runs his own company on paper products, who is an environmentalist, Mike Stout. From the west coast you have a lawyer, Mr. Jim Garner, from Fort Myers and you have a former mayor from Fort Myers as well, Mr. Oscar Corbin. From Palm Beach County you have a farmer, Mr. Fritz Stein, and then from Martin County we have Mr. J.D. York who formerly managed the McArthur Dairies. So you have two farmers on that nine-member board who are——

Mr. STANGELAND. Sounds like they are top heavy with lawyers.

Mr. CREEL. The last board had three lawyers.

Mr. SHAW. I think one lawyer is too much.

Mr. CREEL. And how could I forget, Mr. Nat Reed, who has been on the board longest, and Mr. Reed is a very strong environmentalist.

Mr. SHAW. Is that not something that could be determined very readily so that you and Mr. Finley would be singing from the same hymnbook anyway, with regard to the quality of the water as it leaves the lake, the quality of the water as it comes out of the farming area to the south? I mean it is of vital importance that we find out exactly where this problem is. We certainly do not want to penalize the dairy industry on the north end if they are only part of the problem. Nor do we want to—but I would assume in that you have certainly pinpointed that as a very important area of pollution, and that of course is the source of the pollution coming into the lake, we know that—but I am very concerned. And this is a concern I just picked up. I did not know about this, what is going on down in the south end of this park, and I think this is something, Mr. Chairman, that this Committee may want to take a very hard look at and maybe next year we would even want to come down and have a hearing in the park itself and go on site and see what in the world is happening. Mr. Finley has come up with some very shocking statistics as to the ground that we have lost in the last 8 years since 1980.

What do you see different now than it was in 1980 that would have brought about the cattails and the wading birds leaving this area, the spoonbills and things of this nature?

Mr. CREEL. I think Mr. Finley is quite correct. I think—the fact of the matter is I am not arguing with his statistics on the number of wading birds that have left, we are cooperating very closely with him to go ahead and continue to study to see if those long-term effects can be reversed hopefully. Mr. Shaw, I really do not believe we have a lot of difference with the park. I think our relationship with the park is excellent. I think perhaps the only difference that you have picked up is what I believe—that we believe there is a problem south of the lake. I do not want to tell you that there is not a problem. But I would just say that I think the problem is, if you flush that water directly in, as he indicated, but normally that does not happen. Normally that water goes into the conservation areas and is filtered down through there. And then it does go directly into the park, we know that.

Mr. SHAW. Now let us talk about that filter for just one moment and I am just about out of time. We do talk about the filter through the vegetation, how the vegetation itself takes those nutrients out and how effective the sawgrass is, how ineffective the cattail is. And I guess the cattail is just a stronger plant and just overtakes the sawgrass, is that correct?

Mr. FINLEY. It just replaces it.

Mr. SHAW. Just replaces it simply because it is stronger and it is overbearing. So if we get cattails all over the sawgrass area, we are in deep trouble.

Mr. CREEL. We are in deep trouble.

Mr. SHAW. Deep trouble, that is a polite way to put it.

But the other filtering that I want to talk about though—the vegetation filtering is complete, it is permanent and you do not have to worry about it. I do worry a little about the filtering that is going on in the aquifer. Is this like the—what happens to the stuff once it is in the aquifer? Is it accumulating so that we can determine—or we can say that the aquifer is only going to be a filter for so long and then it is going to become like a swimming pool filter, has to be flushed out but there is not anybody who can flush it out?

Mr. REYNOLDS. That is something that we do not really know and I certainly do not understand. The aquifer for some pollutants is an excellent filter. That is one of the reasons we have been working with the USGS. They have conducted a study for us in south Broward County to look at the effects of septic tanks just for that reason. There are many other pollutants I believe that we need to look at, so that we can better understand the effects of the interaction between pollutants, water and aquifer. The question at this point does not have a real definitive answer.

Mr. FINLEY. Mr. Shaw, may I clarify one of my remarks?

Mr. SHAW. Yes.

Mr. FINLEY. I will be very brief. One of the things that I think Mr. Creel is right about, our concern in not just that the water quality standards are violated occasionally but for developing trends. I used as an example nitrate, as you can see from this chart with the columns of phosphate, we are receiving at the Corps of Engineer structures the S-12 structure, where we get the majority of our water, four parts per billion, which is our natural background level of phosphates. The concern is with that natural sponge, and you can see these levels coming down—it is just like a sponge in your sink, the vegetative sponge will absorb so much and the sponge in your sink absorbs water to the point that it passes it. From a public policy point of view, that is our concern, as the sponge creeps ever south and fails to take up nutrients but begins to pass them down to the next stage, the next stage, that the ultimate stage is Everglades National Park, and that is too late.

Mr. CREEL. And I would certainly agree with him, Mr. Shaw. That is why we have gone ahead and the state is trying to buy up certain lands in the Everglades agricultural area to hopefully move that sponge back up to start taking those nutrients back up into that area rather than moving them further south. We absolutely agree with that, we should not move those nutrients to the park.

Mr. SHAW. Thank you.

Mrs. BENTLEY. Mr. Chairman, I ask unanimous consent to join Mr. Stangeland in submitting some written questions, but I have one I would like to know. Mr. Yoder, I think I know the answer but I wish you would explain what a wellfield is.

Mr. YODER. A wellfield is simply an array of water supply wells which are used for public water supply. Typically for instance we may have 10 to 15 wells located in a cluster that serve together as a major point of withdrawal, perhaps up to 200 million gallons a day.

Mrs. BENTLEY. So it would be for a whole community, not just for a housing development.

Mr. YODER. Right—that is right. In the long-term scheme of things, we see three major wellfields, each perhaps with a capacity on the order of 200 million gallons a day at some point in the future.

Mrs. BENTLEY. We do not have those in my area.

One other comment I have. I will never again be an admirer of cattails. [Laughter.]

Mr. NOWAK. I would just like to ask Mr. DeHihns a question that Mr. Shaw asked about the effect of somehow these nutrients which are flowing out of the lake down past the farming area, getting into the aquifer and going down 100 to 200 feet to your water. You pump it out of that aquifer, is that correct?

Mr. REYNOLDS. Yes, sir.

Mr. NOWAK. And if you are down there, I assume at some point in time these heavier loadings are going to be getting into the aquifer as time passes on, to some degree. And in answer to Mr. Shaw's question, does EPA have any kind of standard for phosphorus or any nutrient level?

Mr. MCGHEE. There is no ground water standard for phosphorus, we have a ground water standard for nitrates.

Mr. NOWAK. What is that standard?

Mr. MCGHEE. That is 10 milligrams per liter.

Mr. NOWAK. What are the consequences if that is exceeded?

Mr. MCGHEE. It would require further treatment at the treatment facility.

Mr. NOWAK. Are some of these individually—wells drilled on individuals' property?

Mr. REYNOLDS. Yes, sir, there are a few hundred people or maybe even a thousand or two in Broward County that have individual wells that are out in the acre-sized estate areas.

Mr. NOWAK. And they just push the water up and drink it. Do they treat it?

Mr. REYNOLDS. I would say all of them have their own home treatment system. It generally consists of something akin to a water softener, quite often a carbon filter.

Mr. NOWAK. Does that take out the nitrates?

Mr. REYNOLDS. I do not think so.

Mr. NOWAK. Yes, were you going to say something?

Mr. MCGHEE. The levels of nitrate right now in the surface water are averaging 0.3 milligrams per liter.

Mr. NOWAK. So they are very low.

Mr. MCGHEE. Very low, compared to the ten.

Mr. CREEL. Mr. Chairman, one of the things I think Mr. Stangeland discussed in earlier testimony was the issue of whether in fact would these toxics cause a problem in fish and what you answered was exactly correct. What you have in many cases with the algae bloom is that, it covers a good portion of the lake itself and it causes a loss of oxygen which then causes you fish kills in some areas because of lack of oxygen. The algae may be toxic itself but it does not affect the water supply and if it does the local water supply companies would heavily treat it at that time with chlorine which would take care of it.

Mr. SHAW. May I ask one more question, Mr. Chairman?

Mr. NOWAK. Certainly, Mr. Shaw.

Mr. SHAW. The same question that I asked the previous panel. Do you think that failure to do anything in Lake Okeechobee would indeed create a dying lake within 20 years?

Mr. CREEL. I think, Mr. Shaw, that—I do not think anybody is willing to give an exact figure. I think most of them have all said—some people have said it is going to turn over next year if you have a bad hurricane, it will do like Lake Apopka and it will turn itself, turn over and you will lose it even next year. Others have said we do not know when the loss will be.

I would answer your question by saying all indications are that if we do not reverse what we are doing, that you will lose the lake eventually.

Mr. SHAW. And the nutrients are accumulating in the bottom of the lake?

Mr. CREEL. The nutrients are accumulating in the soils, in the bottom of the lake, they are accumulating in the grasses and everything within the lake itself.

Mr. SHAW. So a big hurricane or a swirl is not going to be a flushing effect on the lake, it could be devastating.

Mr. CREEL. Could have a devastating effect. Essentially as I understand it—I was not in Florida at the time, but Lake Apopka did essentially that, it turned over.

Mr. SHAW. Thank you.

Mr. NOWAK. Well gentlemen, thank you very much. You certainly added to the total knowledge on this subject.

[The prepared statements of Mr. Creel, Mr. Reynolds, Mr. Yoder follow:]

STATEMENT OF TILFORD C. CREEL, DEPUTY EXECUTIVE DIRECTOR, SOUTH FLORIDA WATER MANAGEMENT DISTRICT

INTRODUCTION

Good afternoon. I am Tilford C. Creel, Deputy Executive Director of the South Florida Water Management District. We are pleased to have the opportunity to speak with you about water management in South Florida—certainly a complex subject that holds significance for our quality of life.

We were requested to provide an overview of the water management system, especially in terms of how the Kissimmee-Okeechobee-Everglades ecosystem interacts, and to discuss significant issues concerning the future of water management. After I describe the system, the issue I will address is the need for improvements to the original water management system constructed 40 years ago.

OVERVIEW

Let me briefly share with you the highlights of the system. Coverage of the District's 16-county jurisdiction, which embraces the 240-mile long K-O-E system from

the Kissimmee Chain of Lakes south to Florida Bay, is an area three times the size of Connecticut.

A network of 1400 miles of canals and levees carries water away from populated areas and farms to prevent floods, and carries water to recharge areas during times of drought. A series of 200 water quality monitoring stations allow the District to determine water quality changes within the system.

Three water conservation areas, located west of Dade, Broward and Palm Beach counties and spanning an area of 1300 square miles, are ringed by levees which allow water levels to be controlled. This allows retention of water from the canal system, alleviating loss of water which otherwise would have been discharged to the sea. The conservation areas also protect the water supply by recharging underlying aquifers.

The multi-purpose water management system can be modified to provide environmental benefits. Examples are the water releases to Everglades National Park in which the structures are operated to let the water flow more closely mimic nature, and the slow or "pulse releases" of water into the estuaries from Lake Okeechobee through certain canals. Large releases of water can upset the saltwater to freshwater balance in the estuary and harm the marine ecosystem.

A glimpse of water quantity and water quality issues within the system provides a better understanding of how the components of the K-O-E interrelate.

Water quantity.—Starting at the top of the system with the Kissimmee River, let me describe the importance of the river to the lake from a water quantity standpoint. Second only to rainfall, which provides Lake Okeechobee with 39 percent of its water, the Kissimmee River represents the largest discharge into Lake Okeechobee with 30 percent of the flow.

Moving farther south, the lake itself serves as a direct water supply for six public water supply utilities directly around the lake, and serves as a backup supply for residents of the lower east coast during times of drought.

The lake was tapped 5 out of the past 18 years to supply water directly to wellfields along the lower east coast during times of severe drought. And, during 11 of the 18 years water from the water conservation areas was used to maintain adequate amounts of fresh water in the coastal canals in order to discourage salt water from reaching drinking water wells, and to help recharge the overall water table.

The frequency of discharges to the water conservation areas from the lake has increased. The District saw the need to augment the supply to these important water recharge areas in 8 of the past 9 years, and in 5 of the past 5 years. Growth has caused a greater demand on the resource.

Farther downstream is the Everglades National Park. While the Park does not receive water directly from the lake, its major source of surface water comes from the southernmost water conservation area. Releases into the park are based on current water conditions in the water conservation area, more natural sheetflow across the 80-square mile wetland Shark River Slough area east of the park, and modified water flows into the park to reduce the incidence of dramatic changes in the flow rate.

Water quality.—The District is concerned about the quality of water flowing through the entire K-O-E system, primarily from the standpoint of the effect changes in water quality have on the environment.

The primary goal of the restoration of the Kissimmee River is to enhance fish and wildlife habitat. Cleansing of the water would be a secondary benefit. Before the Kissimmee was straightened in the 1960s, the original 98-mile river exemplified a pristine and fertile valley. The goal of the restoration is to help return those values.

Although water quality problems in Lake Okeechobee are threats to the fish and wildlife and recreational uses of the lake, these problems, caused by an increase in nutrients such as phosphorus and nitrogen, may not necessarily present a dangerous threat to the water supply. The lake as a drinking water supply would not be rendered unusable should the health of the lake continue to decline. The primary effect would be a potential increase in water treatment costs for direct users. Water conveyed to indirect users through the canal system and recharge areas would have the benefit of being cleansed by the underground limestone formations.

Water quality problems resulting from runoff sent from the Everglades Agricultural Area south of the lake to the water conservation areas presents a threat to these areas. Nearly all of the water from the EAA, 98 percent, was sent to the water conservation areas last year, rather than to the lake. This is because the District is prohibited from sending water to Lake Okeechobee from the EAA during floods, except under certain extreme conditions, in an effort to reduce nutrients reaching Lake Okeechobee. The water conservation areas are experiencing changes in vegetation which do not provide optimal fish and wildlife benefits.

The District is pursuing recommendations of two state technical committees formed during the last three years to address the lake's water quality problems, and resultant downstream impacts to the water conservation areas and estuaries.

The recommendations include ways to reduce the amount of phosphorous reaching the lake from dairy farms to the north. To the south, recommendations include testing the cleansing effect of sending water through marshes before the water reaches the water conservation areas.

While the District is pursuing federal funding for the Kissimmee restoration project, this agency is blessed with the ability to levy ad valorem taxes to generate funds for many of the environmental restoration projects which do not qualify for federal cost-share by the Corps and which the state has not funded through general revenue.

INFRASTRUCTURE NEEDS

In addition to the environmental projects, the District is going ahead with improvements to the infrastructure of the water management system. We are paying our way on projects which we do not think can wait for the Corps planning process or for which the Corps has not contributed funds.

I would like now to focus the remainder of my testimony on the infrastructure issue, an issue which we consider significant to the safety and welfare of south Florida.

The Central and Southern Florida Flood Control Project is 40 years old and in need of repair and modification. The design life of many of the projects in the system is 50 years. Many of the older structures need to be replaced, and much of the system, because of urbanization, needs to be revamped. A number of the canals were anticipated to always be agricultural, never urban.

The original design of the system may not be enough to provide an adequate level of the flood protection if a wet hurricane hits south Florida and drops 10 to 20 inches of rain. And coastal locks and dams, as they stand today, may not be able to restrain the sea water in a serious storm. Polluted drinking water could be the result. South Florida has not experienced such a hurricane in many years, and forecasters warn the pattern could change.

A prime example of where infrastructure has not kept pace with growth is a 64,000 acre canal basin in Palm Beach County known as the C–51 basin. Population has already reached 30,000. This population level was projected in the 1950s to occur in the year 2040. According to today's estimates, the population will reach 150,000 by 2040.

It's going to be expensive to repair the system. The total tab for refurbishing the entire 40-year-old south Florida water management system is estimated at $120 million. Some $500 million was put into building the original system. If the system were to be built today, it would cost between $1.5 billion to $2 billion.

The South Florida Water Management District has made a commitment to accept the responsibility of paying for the majority of the improvements. The District is only at half it millage rate, and it plans to double its construction budget from this fiscal year to the next, and to triple it within the next 5 years.

However, the District is exploring the effect of the new Water Resources Development Act and we see the opportunity to establish a new partnership with the Corps and pursue federal participation in some cases. With the construction tab as large as it is, and because we have a cap on the millage rate, additional outside funding sources will still be needed in the long-term to supplement the District's effort. We are aware of the increase in public works funds and plan to fully explore our options.

CONCLUSION

One way or another, the South Florida Water Management District is committed to ensuring that the system functions properly. The welfare of the people in south Florida, and the integrity of the K–O–E system, depend on it.

STATEMENT OF ROY A. REYNOLDS, P.E., DIRECTOR, BROWARD COUNTY WATER RESOURCES MANAGEMENT DIVISION, OFFICE OF ENVIRONMENTAL SERVICES, PUBLIC WORKS DEPARTMENT, BROWARD COUNTY, FL

Mr. Chairman, honorable members of the House Subcommittee on Water Resources, my name is Roy A. Reynolds and I am director of the Broward County, Florida, Water Resources Management Division. As an engineer, I have worked in the water resources field in south Florida for seventeen years, the last four as direc-

tor of the Water Resources Management Division. During that time, I have had the opportunity to gain some experience and knowledge of the water resources of the area and the interaction of the Federal, State, and local organizations established to protect and utilize those resources.

Most of the people of southeast Florida and all of the residents and visitors of Broward County are dependent upon groundwater from the surficial aquifer system which includes the Biscayne aquifer (attachment 1) as their sole source of drinking water. The source of recharge water for the surficial aquifer system is rainfall. Rainfall that occurs not only on Palm Beach County, Broward County and Dade County, whose political boundaries completely cover the aquifer, but also rainfall from as far away as Orlando in central Florida. Rainfall that is in excess of the receiving areas ability to absorb is either stored in the water bodies that comprise the Federally owned Central and Southern Florida Project (CSFP) (attachment 2) or is discharged to the ocean.

If water is the life-blood of south Florida then the vast and complex network of canals, rivers, lakes, and control structures that comprise the CSFP are our circulatory system, both bringing us fresh water to sustain our bodies and carrying away excess water that would be a threat to our health and life. Thus we in southeast Florida are inextricably tied to both the Federal Government in Washington and our fellow Floridians who live and work within the CSFP. As a result, decisions made in Washington that effect the system have had, and will continue to have, a profound effect upon our lives.

In 1948, when our representatives in Talahassee and Washington agreed to cooperate on a system of water management that would aleviate our historic loss of life and economic damage from recurring catastrophic floods we became dependent upon the project. First our dependency was for flood control and 800 of Broward County's 1200 square miles were set aside as conservation areas to both preserve a portion of the Everglades and to store excessive rainfall that would otherwise have become flood waters in the inhabited areas of Broward County. Similar actions also occured in Palm Beach and Dade Counties. In the 1960's it was realized that the project had begun to serve not only as a flood control project but also as a water supply project. As a result of our rapid growth to a population of over 1.2 million permanent residents and the lack of major storms, the water supply aspect of the project has been paramount for the last two decades. Expectations of the continued growth in importance of the water supply functions of the project have been based on a projected doubling of Broward's population over the next thirty-two years. Therefore, the necessity for very close cooperation in water resources management between Washington, Talahassee, and southeast Florida has been established by past actions.

When decisions that will effect the CSFP are made it should be with full cognizance that the project is now a water resource management system on which the lives, welfare and economic wellbeing of millions of residents are dependent. Decisions that are made without the full realization of effect may appear to be of considerable benefit when viewed in the light of isolated functions. But when viewed from a total resource management perspective, may be seen to be a potential calamity. The results of some past decisions are proof of the argument:

The decision to chanalize certain of the rivers and streams of the upper project were beneficial for flood control and economic benefit but have become known to have been detrimental for conservation and water quality.

Provisions for high level agricultural use of Lake Okeechobee have been beneficial for flood control and agricultural economics but have been detrimental for recreation and water supply.

The water level regimen for lakes and conservation areas appears to have been functioning beneficially for flood control but may not be beneficial for other functions.

These are not necessarily examples of bad decision making. When they were made, the emphasis was on flood control and the preservation of life, the future role of the project was not then known and could not then or now be reasonably expected to have been predicted. That the project has been generally well planned and designed has been shown by its capacity to change from a single purpose system to one of many and varied functions. These decisions were chosen because, though limited in number, they are excellent examples of activities that are undergoing active reconsideration. During the reconsideration process and especially during the decision making process, it is imperative that the CSFP role be seen as a multipurpose water resource management system and that the effects of decisions on one phase of the system will ultimately affect several other phases. If, otherwise considered the upcoming decisions have the potential for disasterous effects. For example, a deci-

sion made to change water level schedules may enhance conservation or water supply but may increase flood potential. Likewise a decision for water supply may be deliterious to other functions. However, in some instances it may be that one function is of such importance that it must be considered above all others. A decision that would adopt a water level schedule beneficial to flood control and water supply, but would be detrimental to the structural integrity of a vital portion of the system would be an example.

Federal, State, and local organizations must be willing to cooperate if the best effort with the least cost is to be achieved. Local organizations should neither be expected to have a complete knowledge of a regional system nor should they squander resources in order to acquire that knowledge, but should be able to receive assistance from the State and Federal levels. Likewise the State and Federal levels should not presume to know "what is best for the locals" but should be willing to work with and understand the requirements, limitations, and "real world" functions at the local level. The relationship should be one of the shared responsibility of partners and not one rife with the senseless squander of entities needlessly duplicating the ability of each other.

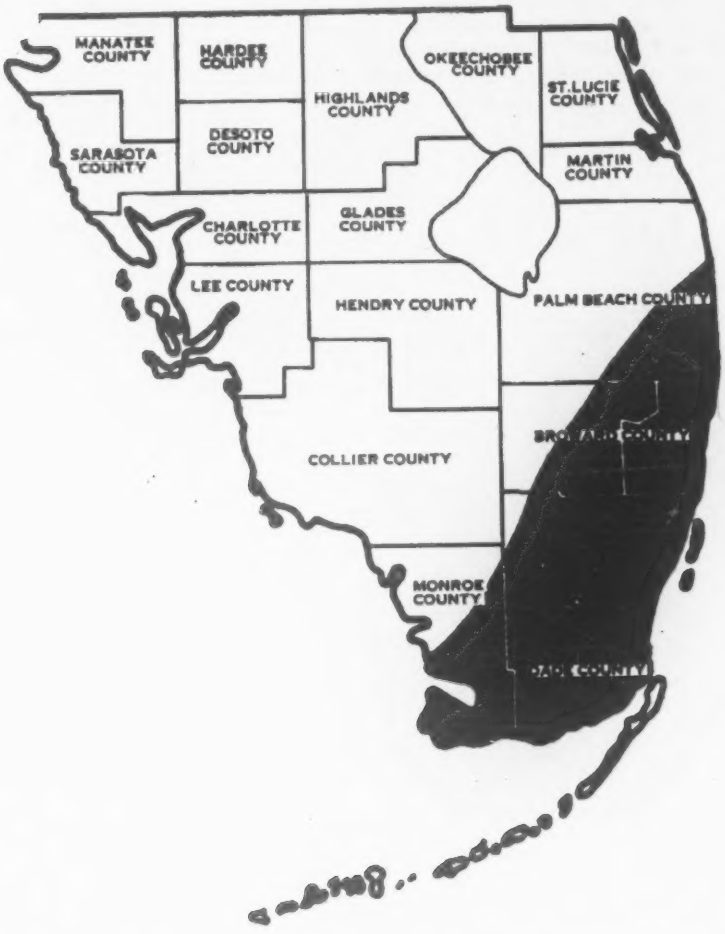
Fortunately the relationship between Federal, State and local districts in the field of water resources has been very good. In Broward County we often work with the U.S. Geological Survey, the U.S. Army Corps of Engineers and the Environmental Protection Agency both directly and through State agencies. Excellent examples of which are the Wellfield Protection Program, Water Supply Program, 201, and 208 programs in Broward County. With assistance from the Federal level, Florida in general and Broward County in particular have moved to the forefront in water resource management. However, there is considerable need to refine our management tools and concepts as our population continues to expand and exert even greater demands on our natural and man-made systems. We are still in a catch-up posture in Broward County even as we plan for our future, thus, Federal and State cooperation will long continue to be essential if there is to be any reasonable chance of understanding our problems and meeting our needs.

Past assistance in the regulation of water resources has been considerably beneficial. The designation of the Biscayne Aquifer in 1980 as a sole source aquifer helped to focus attention on the importance of protecting groundwater. Unfortunately, regulation, data collection, and infrastructure spending remain concentrated on surface water. The out of sight, out of mind syndrome continues to exert itself in water resources. The time has passed when ground and surface waters can be considered separately rather than as parts of the same system. Mistakes made in efforts to prevent pollution of surface water may well be increasing pollution of groundwater and creating a problem with much more difficult and expensive solutions. If the Federal level will move rapidly ahead with the research necessary to support regulations and set minimum standards, the State and local levels can, and should, be expected to adopt and enforce the necessary regulations to protect our water resources.

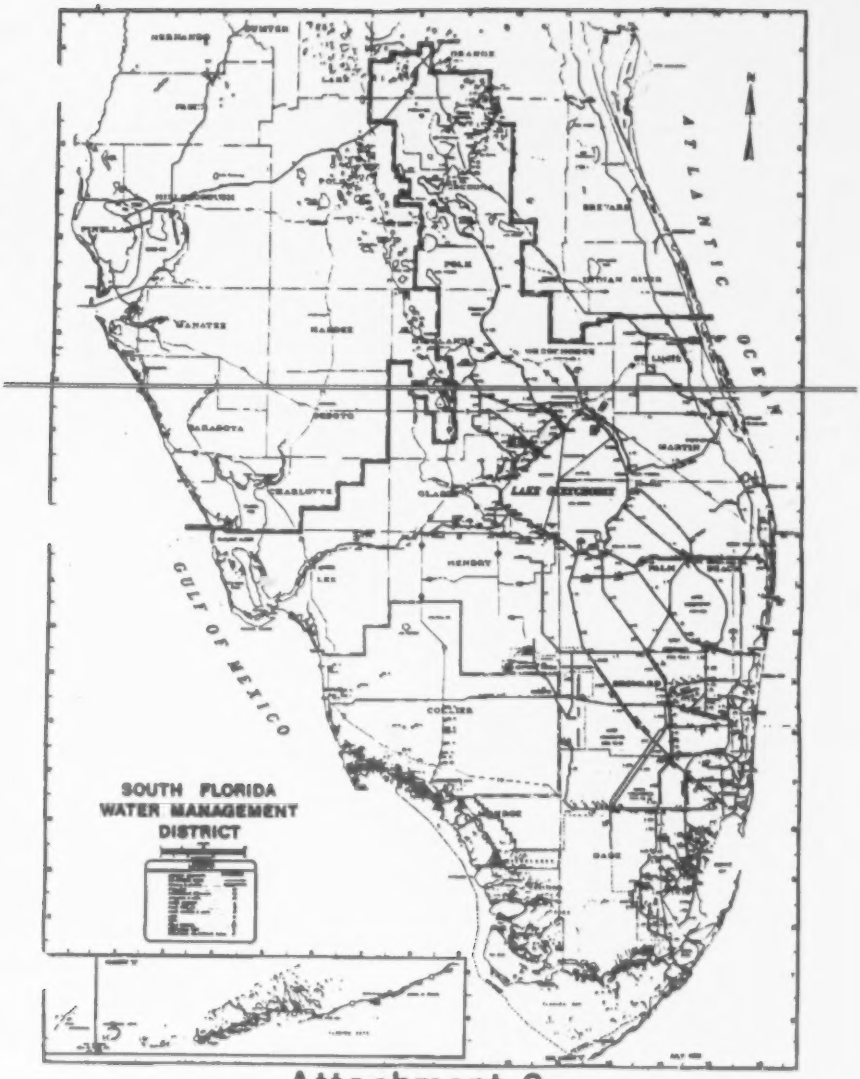
Cooperation and assistance are needed in water supply both in planning and providing infrastructure. Broward County has produced an in-depth study of the problems confronting and methods of assuring a viable, economic long term water supply for its residents and has begun implementation of the resultant water supply plan. But assured success may depend on Federal and State assistance. As a part of the Federal public works appropriations program conducted through the Corps of Engineers, Broward County has requested a joint study under the flood damage prevention and water supply section. Called Broward County comprehensive water management plan, it would determine the future ability of the Central and Southern Florida Project to deliver recharge water to the surficial aquifer system. The recharge ability of the project is the lynchpin upon which the water supply depends. The ability to produce the necessary information is beyond the realm of the local level. The proposed joint study has been approved since 1986 but remains unfunded. This project is an excellent example and opportunity for cooperation with each level providing its share. Broward County has provided at the local level, and is attempting to fund the infrastructure but the sought after Federal assistance has not yet appeared.

Considerable funds have been provided at the Federal level for water resource infrastructure but not for potable water supply. As Broward County has attempted to provide the necessary infrastructure, it has become painfully clear that the demand for capital construction dollars has outstripped our ability to supply. Assistance in the form of grants, no cost loans, or low cost loans is desperately needed. Past capital assistance programs have concentrated on wastewater and drainage. The success of these programs will diminish considerably if we cannot continue to provide high quality, healthful drinking water at an affordable cost.

I want to thank the chairman and members of the subcommittee for this opportunity to address you and welcome any questions that you may wish to ask.



Attachment 1



Attachment 2

BROWARD COUNTY,
OFFICE OF ENVIRONMENTAL SERVICES,
Pompano Beach, FL, June 20, 1988.

Hon. ARLAN STANGELAND,
House of Representatives, 2245 Rayburn House Office Building, Washington, DC.

DEAR SIR: The following replies are in answer to the written questions submitted in your May 27, 1988 letter. I would like to thank you for the interest and concern that you have demonstrated and particularly for your willingness to become informed about our problems and their solutions. If I can ever be of assistance beyond these replies, please do not hesitate to call on me.

1. What do you estimate would be the cost of acquiring the East Everglades Area and what part of the cost do you recommend should be borne by Federal, State, and local governments?

Purchase of the East Everglades Area has been somewhat complicated by the purchase of large areas of agricultural interests that had, until recently, been farming within Everglades National Park. However, it may not be necessary to purchase all of the East Everglades Area in order to provide a workable water management system. The Governor's Land Acquisition Task Force has been examining that possibility and formulating recommendations as to which land should be purchased and which could remain in private ownership. An estimated purchase cost for the entire area would be approximately $92,000,000.00, however, by selective purchase, the cost could be lowered to approximately $25,000,000.00. It is recommended that the purchase cost be borne on a 90/10 split with the Federal side being 90%. This recommendation is based on the fact that the driving force behind the purchase is the need to provide a safe long-term water supply to the Everglades National Park. As such, the benefits accrue primarily to Federal lands.

2. Could you describe what steps Broward County has taken to prevent or minimize development of environmentally sensitive areas?

In the 1940's and 1950's, Broward County agreed that the western two-thirds of the County (approximately 800 square miles) would be set aside as conservation area within the Central and Southern Florida Project. For the last several years Broward County has been attempting to have the Everglades Buffer Strip, an area approximately one-half mile wide by thirteen miles long between U.S. 27 and Conservation Area 3, made a part of the State Save Our Rivers Program. A land use plan, conservation plan, and coastal zone protection plan have been adopted as elements of the Broward County Comprehensive Plan. Through acquisition programs, such as the County's 1978 bond issue, over a thousand acres of sensitive lands have been acquired. Cooperative state-local programs such as the Conservation and Recreation Lands Program and the Save Our Coast Program have added to the acquisition of sensitive lands. Through the various development review processes, developers, Federal, state and local organizations have worked together to protect and preserve hundreds of additional acres. The development review process has also been responsible for wetland mitigation and the construction of aquatic habitats in previously disturbed areas. Tree protection ordinances have served not only to assist in the protection of sensitive lands but also to make funds available for the enhancement of highly desirable areas as a result of development being allowed in less desirable areas.

The regulatory process that has not been directly related to acquisition and preservation of sensitive lands has also begun to have a positive affect. Water management regulations have begun to address the need for a holistic approach. As a result, the effects of water management upon sensitive areas has become a consideration along with the use of wetlands in water management. Regulations have also been adopted to prevent pollution of the Biscayne Aquifer, a sole source aquifer, both countywide and within existing and proposed potable water wellfields. In addition, a water supply program has been implemented that in coordinating with land use and other regulations will serve to protect and provide a long term viable water supply.

In summary, Broward County has had, and continues to have, programs that have enhanced, acquired and preserved over two-thirds of the County as sensitive areas at a cost of millions of dollars. Many of the programs are continuing, with some being periodically strengthened. As a result, it is expected that both on its own and with Federal, state and developer assistance, local government will continue to protect its environmentally sensitive areas from incompatible development.

Sincerely,

ROY A. REYNOLDS, P.E.,
Director, Water Resources Management Division.

STATEMENT OF DOUGLAS YODER, ASSISTANT DIRECTOR, DADE COUNTY ENVIRONMENTAL RESOURCES MANAGEMENT DEPARTMENT

The history of the development of South Florida is integrally tied to water resources and water management. The vast Everglades eco-system extending from Florida Bay to the Kissimmee Basin has been and continues to be the key natural resource which shapes the opportunities for habitability and the many competing interests which depend upon and impact that resource. It is clear that the Everglades eco-system will never return to its original condition. It must forever more be a highly managed system to balance the needs of urban residents, agriculture, and the natural system itself which is represented by Everglades National Park and the Big Cypress Preserve. In the short term these needs may seem to compete. There is more and more evidence, though, that the continued viability of the basic Everglades eco-system is crucial to the future of all human activities on the lower east coast. A better technical understanding of this complex system in connection with heightened public awareness of threats to the system make this a fortuitous time for comprehensive action by all levels of government.

The federal government, of course, has been a key player in the historic transformation of the Everglades basin from a totally natural system driven by climate to a managed system driven by competing needs for flood control and water supply. The enormous canal and levee systems have been remarkably successful in making thousands of acres of land available for agriculture and urban development. The unanticipated or unappreciated side effects of this transformation have led us to a changing view of system management. Instead of "flood control," we now speak of "water management," a term that has broadened the context of responsibilities for these agencies which must make the day to day operational decisions.

While the regional water management system has been and is a state and federal responsibility, local government is an active partner and an interested party in the outcome of water management. In particular, Dade County has undertaken several initiatives which both depend upon and complement federal and state actions. Dade County is larger than the state of Delaware, has a resident population of more than 1.8 million people, and plays host to millions of tourists and visitors each year. The metropolitan government has areawide responsibilities for water supply, environmental management and land use control in the unincorporated areas. The County is flanked on the east by Biscayne National Park and on the west of Everglades National Park, thereby underscoring both the national significance of these splendid resources and the extraordinary stewardship responsibility which local government must exercise.

Two case examples of the ways in which local government can exercise this type of responsibility are worthy of mention. The first example has to do with a management plan for the East Everglades area. In the mid-1970's it became clear that pressure for development in the East Everglades was mounting. The East Everglades is a 250 squre mile area of largely undrained land located adjacent to and east of Everglades National Park, south of water conservation areas along the Tamiami Trail, and west of the levee which divides the drained area of the County from the undrained area. Comprised largely of undeveloped and undisturbed wetlands with seasonal flooding, this area is an important part of the original Everglades drainage way. It contains habitat for endangered species and serves as a major recharge area for the Biscayne Aquifer, Dade County's sole source of drinking water. In a major scientific and policy study of the East Everglades conducted by County, state, and federal agencies, it was concluded that development in the East Everglades should be minimized. Drainage of the area to make it suitable for urban development would be disastrous from an environmental and aquifer recharge point of view. As a direct result the land was rezoned to require 40 acres for each housing unit in place of the 5 acre zoning which prevailed at the time. A provision was included for the transfer of development rights to enable property owners an alternative use, and selected areas were designated as suitable for farming. Existing lots were not grandfathered, so in spite of the fact that the area is highly parcelized as a result of years of land speculation, the rezoning has been effective in virtually halting development in the area. Short of acquisition, this land use control was the only way to effectively preserve the area.

A second area in which Dade County has acted responsibly and exercised leadershp is in the area of water supply and wellfield protection. Dade County operates a regional water and sewer system that provides wholesale and retail services. By using the economic capacity of a large utility, major regional water supply wellfields and treatment plants have been constructed or are planned. In the late 1970's, with the advent of sophisticated analytical devices and techniques, it became evident that

certain types of land uses are incompatible with the protection of wellfields in a very shallow and highly porous aquifer such as the Biscayne. In particular industrial and commercial land uses involving the storage of hazardous materials and the generation of hazardous wastes were recognized as the most serious threat to wellfields. Dade County has enacted one of the most comprehensive groundwater and wellfield protection programs in the nation, a program which has served as a model for the state and the federal wellhead protection program. Using sophisticated computer models, protection zones have been delineated for all wellfields. Within these zones land uses are progressively controlled with respect to intensity and denity of use as the wells are approached. The most significant constraint is a prohibition of uses which utilize hazardous materials within the protection areas. Gas stations, plating shops, photo processing labs, and dry cleaners are examples of uses which are not permitted in proximity to wellfields. Given that some of the protection areas encompass 50 to 70 square miles, these retrictions are significant. Coupled with these land use controls are special treatment requirements, an aggressive monitoring and enforcement program, a water management program to separate areas of existing contamination from wellfield areas, and a public education program.

Each of these examples illustrates the intergovernmental nature of reconciling the natural and urban system. Each level of government has a role to play. In that regard we can make certain specific recommendations with respect to the important continuing federal role:

1. Dade County strongly supports the ongoing General Design Memorandum project for restoring flow through the Northeast Shark River Slough. This has important implications for protection of Everglades National Park and for maintaining adequate ground water recharge for urban water supplies.

2. Dade County strongly supports the Joint state and federal initiative to acquire the East Everglades as a public preserve. While the County has done everything feasible to protect the areas from inappropriate development, it is now clear that the public interest will best be served by incorporating this area directly into the regional water management system.

3. The Corps of Engineers and other federal agencies must maintain a continuing interest in the regional water management system that includes integration of urban water supply, flood control, and wetlands protection issues. For example, Dade County is now siting a new wellfield which may require a supportive canal system to control potential adverse impacts on adjacent wetlands. Also, Dade County has initiated a basin planning program to identify comprehensive plans for development of secondary wetlands within the drained area of the County in such a way that wetland values, recharge potential, drainage requirements, and development rights are all addressed. This approach is being supported by state and federal agencies and promises to be a much more productive method than responding to individual development applications.

4. The federal agencies must continue to lead in terms of development of water quality standards, best management practices, analytical techniques and other research and development which can best be done at the national level. For this the Environmental Protection Agency requires adequate funding and direction. In addition the many regulatory programs which have been bolstered through amendments to the Safe Drinking Water Act and the Clean Water Act, among others, can only be as effective as the resources available for implementation. To date the resource commitments do not support the congressional mandates. The federal wellhead protection program is an example.

5. Finally, an area of emerging concern that impacts the entire Kissimmee River/Everglades Basin and attendant ground water systems is management of agricultural chemicals. This is a problem of nationwide concern with respect to surface water, ground water, and wetlands. Congressional legislative and financial support for a comprehensive strategy to manage agricultural activities to minimize contamination of our water resources is imperative.

We are grateful for the opportunity to share these observations with the subcommittee.

[The following was submitted by Mr. Finley:]

Science

Nutrient Enrichment in the Everglades

Daniel J. Scheidt
National Park Service, Everglades National Park
Homestead, FL

Water is the lifeblood of Everglades National Park. For centuries the quantity and quality of water in the area have resulted in a unique mosaic of ecosystems. In recent years, however, water management and nutrient loading have upset the area's natural hydrologic system, threatening the ecological integrity of the Everglades wetland ecosystem.

Established in 1947, Everglades National Park is located in southern Florida at the receiving end of the Kissimmee River-Lake Okeechobee-Everglades hydrologic system. Historically, water from the Kissimmee River flowed unimpeded southward to Lake Okeechobee. During the wet season, water originating from rainfall flowed southward through the 10,500 square kilometer Everglades marsh as shallow surface water sheet flow to what is now the Park.

Today, this hydrologic system is entirely managed, utilizing a complex system of over 1400 miles of canals, 18 pumping stations, and 125 control structures. This system, the Central and Southern Florida Flood Control Project, was constructed by the Army Corps of Engineers at a federal cost of 400 million dollars. Over the years, the Corps has channelized the Kissimmee River and diked Lake Okeechobee. The historic Everglades region south of the Lake now consists of three functional units (Figure 1):

1. *Everglades Agricultural Area (EAA).* Encompasses 2800 square kilometers of drained wetlands which are currently used for large-scale, agrichemical-intensive production of sugarcane and winter vegetables. Four pumping stations help drain EAA soils by pumping water from the fields into canals which feed southward into Water Conservation Area wetlands.

2. *Water Conservation Areas (WCAs)*. 3400 square kilometers of state-owned shallow water reservoirs maintained primarily for flood control and water supply.

3. *Everglades National Park*. The southernmost unit in the hydrologic system encompassing 5700 square kilometers. The Park is preserved for wilderness, wildlife habitat, and recreation.

The Park is the last to receive water in this intricate system and therefore may be affected by management actions 80 miles upstream. In recent years nutrient enrichment has become a particular concern because water delivered to the Park may originate from or pass through areas that have the potential to alter or degrade the quality of the water. Unfortunately, water management has not been entirely successful. Management decisions throughout the system are often conflicting and complex; the solution of one problem sometimes results in the creation of another.

Everglades Water Quality

Portions of the Everglades marsh have extremely low natural nutrient levels (Flora and Rosendahl, 1982; Waller, 1982). Historically, scientists believe that the Everglades ecosystem was limited by the nutrient levels in rainfall. Recent data, however, suggest that dramatic differences in nutrient levels exist in the Everglades and that the marsh is being subjected to artificially high nutrient levels.

A 1985-87 study of the freshwater marsh within the Park found dissolved phosphate concentrations at 4 parts per billion (ppb) and dissolved nitrate concentrations at 10 ppb. Water in Lake Okeechobee, the EAA, and the WCAs had much higher nutrient levels, ranging from 100 ppb phosphate in Lake Okeechobee to 355 ppb phosphate near vegetable farms (Federico et al., 1981; CH2M Hill, 1978).

In water entering one of the Water Conservation Areas from the Everglades Agricultural Area, soluable nitrates have even reached 2165 ppb, a 216-fold increase in background Everglades marsh levels. Overall, Mattraw, et al. (1987) and others have documented an increase in soluable nitrate, soluable phosphate, and conductivity in water draining from the Everglades Agricultural Area to the Water Conservation Areas.

Impacts of Nutrient Loading

Years of nutrient enrichment in the Water Conservation Areas have induced biological changes in these wetlands. In the Arthur R. Marshall Loxahatchee National Wildlife Refuge (WCA 1) and other areas, cattails have expanded and replaced native sawgrass communities. The spatial diversity and complexity of the marsh have decreased and natural daily dissolved oxygen fluctuations in the water column have been nearly eliminated. Native wetland algae, plants, and other organisms have also been replaced by more pollutant-tolerant species. In summary, the marsh has become a less healthy, less diverse, heterotrophic system.

If waters containing nutrients at concentrations present in Lake Okeechobee, the Everglades Agricultural Area, or the northern Water Conservation Areas consistently reach the Park, the Park's marshes may suffer biological changes. Such changes would violate the following:

1) the intent of the U.S. Congress in establishing Everglades National Park, by impairing the enjoyment of the area by future generations;

2) the legislative mandate of the National Park Service, by destroying the natural abundance, behavior, diversity and ecological integrity of the ecosystem; and

3) Florida's SWIM Act, by violating state water quality standards and affecting native vegetation communities and wildlife.

Somewhat ironically, the Florida Administrative Code[1] requires that nutrient concentrations in bodies of water like the Water Conservation Area reservoirs not be altered so as to "cause an imbalance in natural populations of aquatic flora or fauna." As "Outstanding Florida Waters," WCA 1 and the Park are required to maintain high quality water. Despite this, the Florida Department of Environmental Regulation, the state agency responsible for Florida water quality standard enforcement, has taken no action to try to improve water quality.

Nutrient Unknowns

It is difficult to anticipate the precise impact of nutrient loading because little is known about nutrient cycling in the Everglades system. The ultimate fate of nutrients is also poorly understood. In peat sediments in the Everglades, only 15 percent of added nitrate was removed from the system by denitrification. The rest remained in other forms, possibly further altering the nutrient processes in the marsh (Gordon, 1986).

While scientists have documented the nutrient uptake in plants and sediment, they have not yet documented the long-term nutrient induced changes in marsh algae, plants, and animal communities or the reversibility of such changes should nutrient loading decrease. More data is also needed on the assimilative and filtering capacity of the Water Conservation Area marshes and the rate of movement of the nutrient front as upstream marshes become saturated. Once scientists have a better understanding of these factors and the Everglades nutrient cycling processes, they will have a clearer idea of the possible range of impacts on the Park ecosystem.

Solutions

In 1979, the South Florida Water Management District initiated the Interim Action Plan, a management strategy that attempts to minimize the pumping of nutrient-rich water from the Everglades Agricultural Area northward to the Lake. To prevent eutrophication of Lake Okeechobee, nutrient-rich water from the EAA is kept out of the Lake and sent south toward the WCAs and the Park. In late 1986, a technical committee formed to help solve the Lake's eutrophication problem recommended that the plan be continued indefinitely.

Unfortunately, the management actions implemented to solve one water quality problem exacerbated another. From 1979 to 1986, 10,200 tons of nitrogen and 258 tons of phosphorous were diverted from the Lake to the WCAs and the Park. This represents a 17 percent increase in phosphorous loading and a 30 percent increase in nitrogen loading since 1973-1978 (SFWMD, 1987). Acknowledging this problem, the 1987 Florida legislature assigned a group of eleven scientists and engineers to "investigate the adverse effects of past diversions of water and potential effects of future diversions on indigenous wildlife and to report to the legislature, no later than March 1, 1988, with findings

1. Fla. Admin. Code 17-3.121(19).

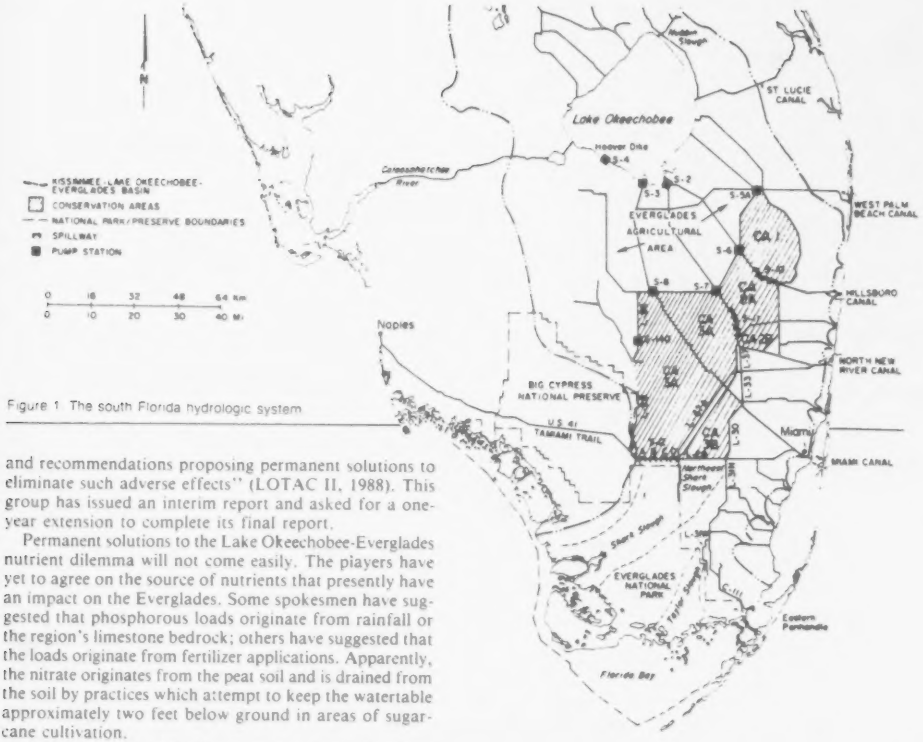


Figure 1. The south Florida hydrologic system

and recommendations proposing permanent solutions to eliminate such adverse effects" (LOTAC II, 1988). This group has issued an interim report and asked for a one-year extension to complete its final report.

Permanent solutions to the Lake Okeechobee-Everglades nutrient dilemma will not come easily. The players have yet to agree on the source of nutrients that presently have an impact on the Everglades. Some spokesmen have suggested that phosphorous loads originate from rainfall or the region's limestone bedrock; others have suggested that the loads originate from fertilizer applications. Apparently, the nitrate originates from the peat soil and is drained from the soil by practices which attempt to keep the watertable approximately two feet below ground in areas of sugarcane cultivation.

The Army Corps of Engineers, the South Florida Water Management District, agricultural interests, and others must now pursue new water management options, nutrient source reduction, and technology for treating drainage water. At present, treating the drainage water poses an engineering challenge, due to the large volume of EAA drainage water and the fact that nutrient concentrations are too low for conventional treatment technology. Experts have proposed using biological treatment to meet the 30 ppb phosphate loading goal for the Water Conservation Areas. Four hundred acres have already been set aside for demonstration projects currently under design. Finding and implementing a successful treatment process may take five to ten years, at best.

The source of funding for water treatment has yet to be determined. Costs could total hundreds of millions of dollars. The agricultural industry proposes that public land and water be used for the cleanup and that no agricultural land be taken out of production and set aside for water treatment. Ultimately, the political process will determine the funding source and the time frame for the project. Until a comprehensive approach to permanently control any excessive nutrient loading is in place, the ecological integrity of this nation's most famous wetland will remain threatened.

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- Conferences, Symposia and Workshops

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WATER QUALITY MANAGEMENT FOR EVERGLADES NATIONAL PARK

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ABSTRACT

The wetland ecosystems of Everglades National Park are located at the receiving end of the nutrient-impacted Kissimee River-Lake Okeechobee-Everglades watershed. Water is delivered to the Park by an intensively managed system of over 125 water control structures and 1400 miles of canals and levees, which provide water for agriculture, water supply storage, urban wellfield recharge, and maintenance of natural wetlands. Water management decisions throughout the system are complex, with the solution of one problem sometimes resulting in the creation of another. The National Park Service has undertaken monitoring and research activities to protect the high quality of water in Everglades National Park. These activities include: development of unique water quality standards; establishment of cooperative long-term monitoring programs; and a controlled nutrient dosing study documenting major impacts on wet prairie periphyton and macrophyte community composition and primary productivity resulting from slight increases in water nutrient concentrations (0.027 mg/l dissolved phosphate as P and 0.085 mg/l dissolved nitrate as N). The results of these activities indicate that if waters containing nutrients at concentrations present in Lake Okeechobee, the Everglades Agricultural Area, or the northern Water Conservation Areas reach Everglades National Park, unacceptable biological changes in the park marsh resource can be expected to occur. Nutrient-rich water from the Everglades Agricultural Area has already caused extensive biological changes to the Everglades Water Conservation Area marshes north of Everglades National Park. These biological changes violate Florida water quality standards. Such changes to the park would violate the legislative mandate of the National Park Service as defined by the United States Congress. These changes may have far-reaching consequences to the ecological balance of this delicate ecosystem. The reversibility and long-term extent of such biological changes are poorly understood.

INTRODUCTION

Everglades National Park occupies 5700 square kilometers at the southern tip of Florida (Figure 1). The park was established in 1947, and contains one-fifth of the historic Everglades marsh. In the 1934 legislation which authorized the Park, the U. S. Congress stated that the area "shall be permanently reserved as a wilderness" and no activity should be undertaken "which would interfere with the preservation intact of the unique flora and fauna and essential primative natural conditions now prevailing in the area" (16 U. S. Code 410c). Water is the lifeblood of the Everglades. It is the quality of water and the quantity of water (volume, distribution, and timing) that have produced the myriad of ecosystems and unique assemblages of wildlife for which the Everglades are famous.

The Kissimmee River-Lake Okeechobee-Everglades system is one hydrologic unit. Historically, water from the Kissimmee River flowed unimpeded southward to Lake Okeechobee. During summer wet season conditions water could flow over the Lake's southern rim southward as shallow sheet flow through the Everglades marsh. Today, this hydrologic system is entirely managed, utilizing a complex system of over 1400 miles of canals, 18 pumping stations and 125 control structures. This system, the Central and Southern Florida Flood Control Project, was constructed at a cost of over $500 million, and is operated by the South Florida Water Management District and the U. S. Army Corps of Engineers.

The Kissimmee River has been channelized, and Lake Okeechobee is surrounded by a dike. The historic Everglades region south of the Lake today consists of three functional units. These are the Everglades Agricultural Area (EAA), the Water Conservation Areas (WCA's), and Everglades National Park (Figure 1). The EAA encompasses 2800 square kilometers of drained Everglades wetlands, mostly within Palm Beach County. This area is currently used for agrichemical-intensive sugarcane and winter vegetable production. Palm Beach County pesticide sales for agriculture in 1982 were $27.5 million, and fertilizer sales were $26.5 million (U. S. Department of Commerce, 1982). The Water Conservation Areas (Areas 1, 2A, 2B, 3A, and 3B) are water storage reservoirs that cover over 3400 square kilometers, are enclosed by levees, and are managed largely for water supply and flood control.

Everglades National Park is the southernmost unit of this hydrologic system. As such, the park is the last receiver of water in this system. Water is delivered to the park in four major areas (Figure 1): 1) overland sheet flow from Big Cypress National Preserve southward to the western reaches of the park; 2) discharge to Shark River Slough from WCA3A via the four S-12 gates located along the Tamiami Canal; 3) discharge from canal L-31W and structure S-332 into Taylor Slough; and 4) discharge from cutouts in canal C-111.

Water delivered to the park may originate from or pass through areas that have the potential to alter or degrade the quality of the water. Eutrophic conditions in Lake Okeechobee

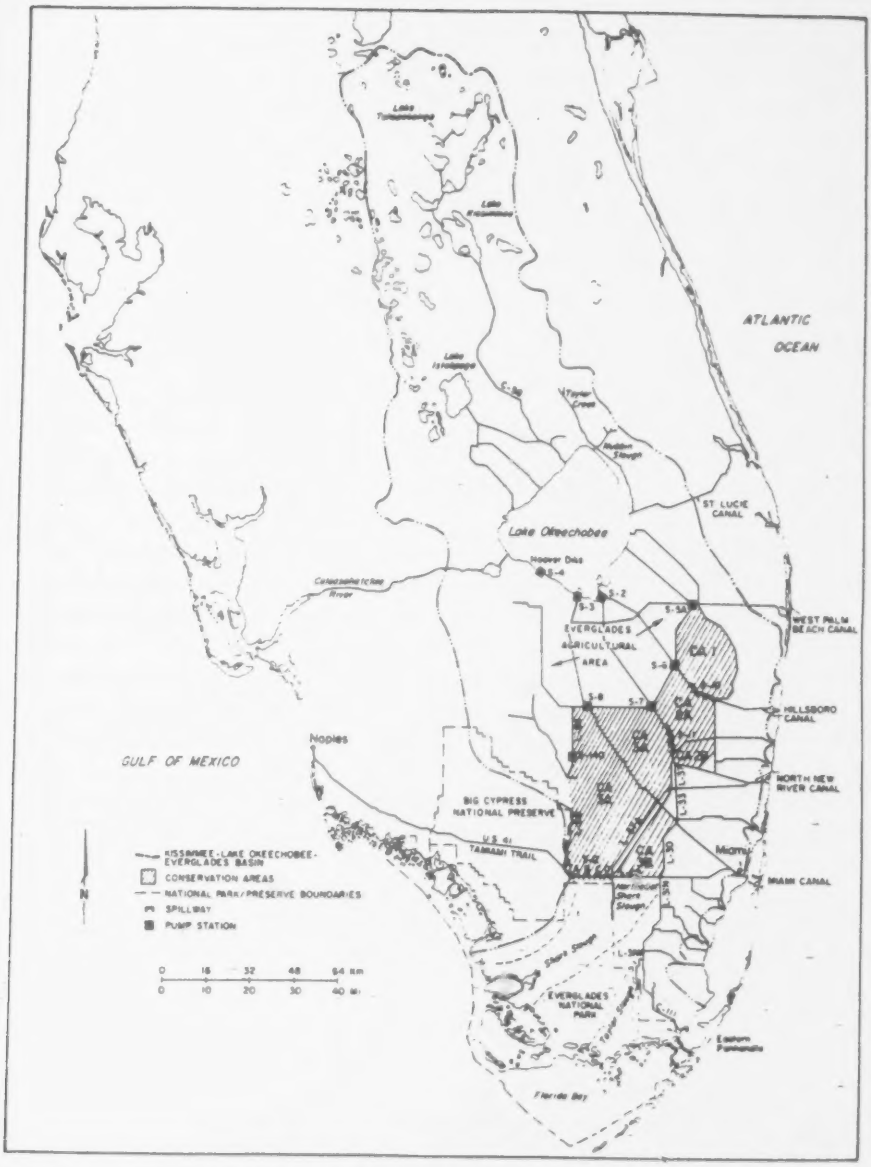

Figure 1. South Florida hydrologic system showing areas of water delivery to Everglades National Park, the Kissimmee River, Lake Okeechobee, Everglades Agricultural Area, Water Conservation Areas, and Big Cypress National Preserve.

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were documented as early as 1969 (Joyner, 1971) and have since worsened. Water quality is degraded in the EAA, and portions of the Water Conservation Areas have been biologically impacted by nutrient-rich water. What follows is a brief description of activities undertaken by the National Park Service to protect the high quality of water upon which the park depends.

WATER QUALITY STANDARDS DEVELOPMENT

In 1970 the U. S. Congress established a minimum water delivery schedule for Everglades National Park (PL. 91-282). Concurrently, Congress directed the U. S. Army Corps of Engineers and the National Park Service to take measures to "assure that the water delivered to the Park is of sufficient purity to prevent ecological damage or deterioration of the Park's environment" (U. S. Senate, 1970). In addition, Congress directed the National Park Service to report on the park's water quality needs. This led researchers at the park to develop water quality standards for waters delivered to the park. Rosendahl and Rose (1979) employed control chart theory to statistically derive standards based upon local water quality conditions. These standards are unique to Everglades National Park, and are based on historic USGS water quality data for 1970-1978 at two canal sites immediately north of the park (S-12C and L-67, Figure 1). The developed standards for each parameter are more than two standard deviations above the sample mean. These standards for delivery waters to Everglades National Park were adopted by the U. S. Army Corps of Engineers (USACOE), the South Florida Water Management District (SFWMD), and the National Park Service (NPS) in 1979 by the signing of an interagency Memorandum of Agreement (Table 1).

WATER QUALITY MONITORING

Two water quality monitoring programs are presently in effect for Everglades National Park. The first monitors the quality of water at sites in each basin of water delivery to the park, and is mandated by the Memorandum of Agreement (Figure 2). Water samples are taken monthly by the USACOE and the SFWMD, and are analyzed for nutrients, ions, and heavy metals (Table 1). Water samples are analyzed quarterly for pesticides, and sediment samples are taken quarterly and are analyzed for heavy metals and pesticides.

Violations of the park water quality standards from 1984 to 1986 are summarized in Table 2. The Memorandum of Agreement specifies that the annual mean for a parameter at a particular sampling site must exceed the standard for a violation of the agreement to occur. Several violations were noted during these years, most frequently for dissolved oxygen and pH. Other violations of notable concern include phosphate, ammonia, iron and conductivity.

PARAMETER	STANDARD*
PHYSICAL PARAMETERS	
Dissolved Oxygen (mg/1)	4.5
Specific Conductance (umho/cm^2 @ 25^{o}C)	647
pH (units)	7.6-8.0
Temperature (^{o}C)	not applicable
Color (PCU)	124
Turbidity (NTU)	11
NUTRIENTS	
Ortho Phosphorus (mg/1 as P)	0.02
Total Phosphorus (mg/1 as P)	0.24
NO_2 (mg/1 as N)	0.04
NO_3 (mg/1 as N)	0.7
NH_4 (mg/1 as N)	0.24
Organic N (mg/1 as N)	2.1
BIOLOGICAL PARAMETERS	
BOD (mg/1)	3

PARAMETER	STANDARD*
IONS	
Calcium (mg/1)	86
Magnesium (mg/1)	25
Sodium (mg/1)	93
Chloride (mg/1)	143
Iron (ug/1)	270
Alkalinity (mg/1 as $CaCo_3$)	269
TRACE METALS	
Mercury (ug/1)	0.5
Cadmium (ug/1)	10
Copper (ug/1)	8
Lead (ug/1)	13
Zinc (ug/1)	72
Arsenic (ug/1)	20

* *Annual mean not to exceed this value. For dissolved oxygen, annual mean not to be less than this value.*

Table 1. Everglades National Park water quality standards for delivery water (Rosendahl and Rose, 1979).

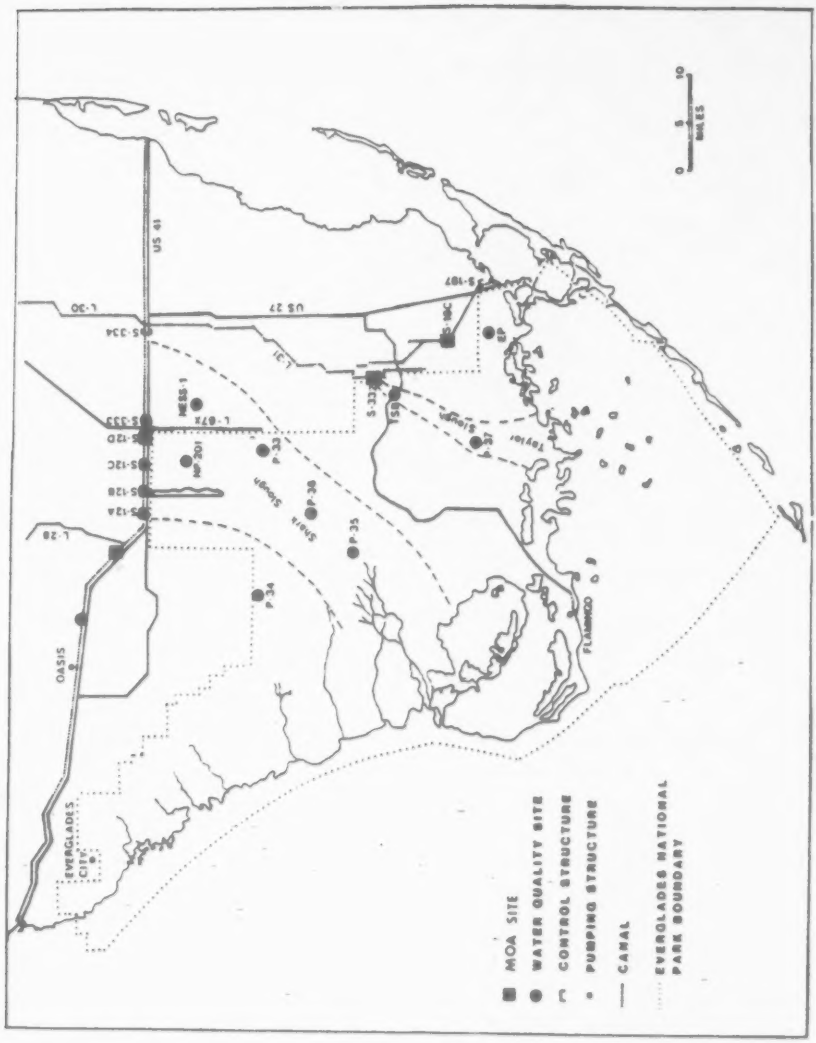

Figure 2. Everglades National Park water quality sampling sites.

Table 2. Violations of Everglades National Park water quality standards at points of water delivery, 1984 - 1986. The annual mean for a station parameter must exceed the standard for a violation to occur. Data are from USACOE and SFWMD.

	BIG CYPRESS		SHARK SLOUGH		TAYLOR SLOUGH		C-111	
	ENP-15	US 41-25	L-67A	S-12D	S-332		S-18C	
	COE	WMD	COE	WMD	COE	WMD	COE	WMD
1986	DO	DO	DO	DO	DO	DO	--	DO
	pH	pH	pH	pH	pH	pH	--	pH
	Turbidity	--	--	--	Turbidity	--	Turbidity	--
	--	--	--	--	FE	FE	--	FE
	--	--	--	--	(NH_3)	--	NH_3	--
	--	--	Cond	--	--	--	Cond	--
1985	DO	DO	DO	DO	--	DO	DO	--
	pH	pH	pH	pH	pH	pH	pH	pH
	PO_4	--	PO_4	--	PO4	--	--	--
	--	--	Cond	--	--	--	Cond	--
	--	--	--	--	FE	--	--	--
	BOD							
1984	ND*	ND*	DO	DO	DO	DO	--	--
	"	"	pH	pH	pH	pH	pH	pH
	"	"	FE	--	FE	FE	--	--
	"	"	Cond	Cond	---	--	--	--
	"	"	K	--	--	--	--	--
	"	"	--	--	Turbidity	--	Turbidity	--
	"	"	Mg	--	--	--	--	--
	"	"	--	--	NH_3	(NH_3)	--	--

* No data available

The second sampling program takes samples monthly at 9 marsh sites within or near Everglades National Park (Figure 2). These water samples are transferred to the SFWMD laboratory for determination of ion, nutrient, and heavy metal content. The SFWMD provides these analyses at no charge to the National Park Service. This program was initiated in the fall of 1985.

PRESENT EVERGLADES WATER QUALITY

The interior Everglades marsh is extremely oligotrophic in regard to ambient water column nutrient levels and nutrient availability (Flora and Rosendahl, 1982; Waller, 1982). Recent nutrient data (1985 - 1987) for the unimpacted freshwater marsh within Everglades National Park indicate that dissolved phosphate concentrations are typically at the detection limits of the SFWMD lab (0.004 mg/l or 4 parts per billion) while dissolved nitrate concentrations are typically about 0.010 mg/l (10 parts per billion). Water in Lake Okeechobee, the Everglades Agricultural Area (EAA), and moving from the EAA south toward the Water Conservation Areas and ENP contain nutrient levels much higher. Soluble phosphate levels in Lake Okeechobee are about 0.100 mg/l (100 ppb) and nitrate levels also average 100 ppb (Federico, et al., 1981). Dickson, et. al (1978), CH2M Hill (1978), and Lutz (1977) report elevated nutrient concentrations in canals within the EAA. CH2M Hill (1978) report a mean phosphate concentration of 355 ppb near vegetable farms, and a mean nitrite plus nitrate concentration of 2720 ppb near sugarcane.

Annual mean nitrate and phosphate levels at structures surrounding Water Conservation Area 3A, immediately north of ENP, are shown for 1986 in Figure 3. Nitrate levels at structure S-5A were 2165 ppb, representing a 216-fold increase above background Everglades marsh levels, while levels at structures S-7 and S-8 were 1250 ppb and 1257 ppb, representing a 126-fold increase above background marsh levels. Phosphate levels at S-7, S-8, and L-3 ranged from 54 ppb to 65 ppb, representing a 13 to 16- fold increase above background Everglades levels. Water entering the park through the S-12 gates during 1986 was at the detection limits for phosphate (4 ppb). During 1985 mean soluble phosphate concentrations at the S-12 gate ranged from 10 ppb to 17 ppb. During 1986 mean nitrate levels at S-12D (Figure 3) were over 6 times levels at S-12A. Nitrate levels increased from west to east with S-12D typically delivering the poorest quality water to the park due to the influence of the L-67A canal and its ability to move degraded EAA water southward. Mattraw, et. al (1987) document a similar areal pattern from 1978-1982 for nitrate, phosphate, and conductivity. Clearly, dramatic areal differences in nutrient levels exist in the Everglades marsh, and the Everglades is being subjected to artificially high nutrient levels (Table 3).

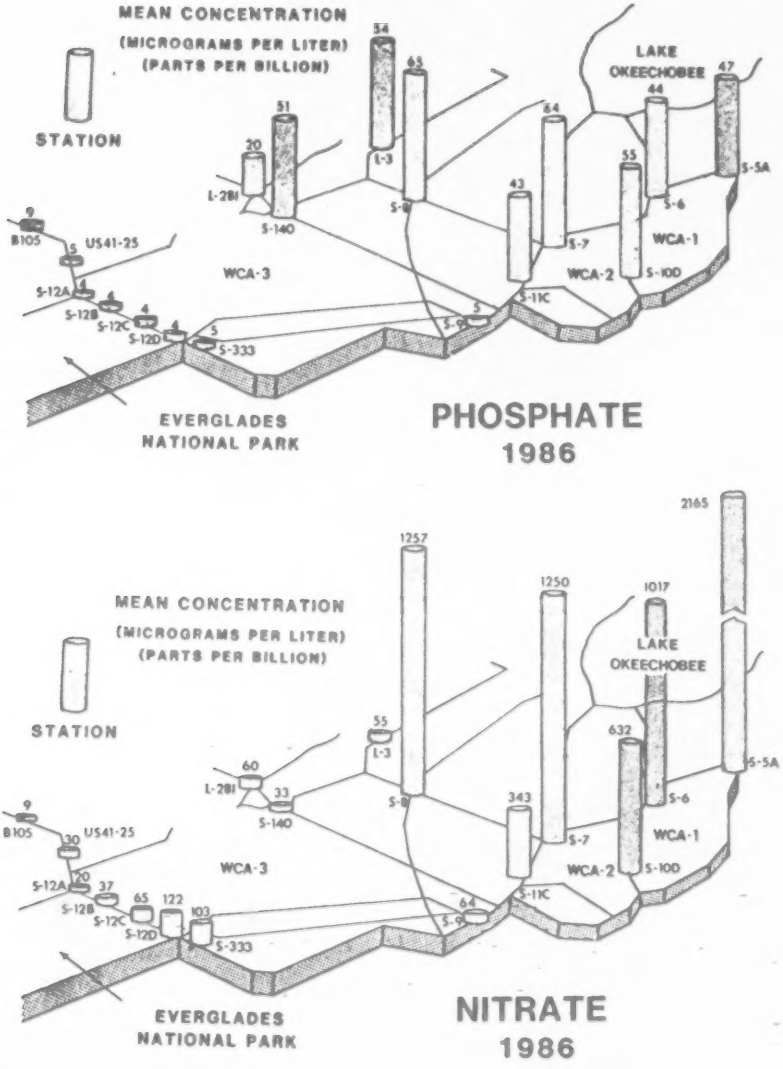

Figure 3. Mean annual 1986 dissolved phosphate concentration and nitrate concentration (parts per billion) at structures surrounding Everglades Water Conservation Area 3A, immediately north of Everglades National Park. Background Everglades marsh phosphate concentration is 4 ppb and background nitrate concentration is about 10 ppb (data from SFWMD).

Table 3. Areal differences in present Everglades phosphate and nitrate concentrations.

EVERGLADES PHOSPHATE CONCENTRATIONS	EVERGLADES NITRATE CONCENTRATIONS
UNIMPACTED EVERGLADES MARSH	UNIMPACTED EVERGLADES MARSH
4 ppb (1x)	10 ppb (1x)
ENP DOSING STUDY	ENP DOSING STUDY
33 ppb (8x)	96 ppb (8x)
LAKE OKEECHOBEE	LAKE OKEECHOBEE
100 ppb	100 ppb
INFLOWS TO WATER CONSERVATION AREAS	INFLOWS TO WATER CONSERVATION AREAS
40 ppb - 101 ppb (1986, 10x - 25x)	1017 ppb - 2165 ppb (1986, 101x - 216x)
CANALS WITHIN THE EAA	CANALS WITHIN THE EAA
355 ppb (90 x)	2700 ppb (270 x)

Years of nutrient enrichment in the Water Conservation Areas has induced biological changes in these wetlands. Documented changes include an expanding area of cattail replacing sawgrass in WCA 2A (Davis, 1986), changes in periphyton toward more pollutant-tolerant species and a decrease in species diversity (Swift, 1981, Swift and Nicholas, 1987), a near elimination of the strong daily water column dissolved oxygen fluctuations that are a characteristic of the unimpacted Everglades marsh such that mid-day dissolved oxygen is nearly undetectable (Belanger and Platko, 1986), and a shift toward anaerobic organisms in bacterial communities that colonize decomposing macrophytes (Reeder and Davis, 1983). Similar changes have been documented in Loxahatchee National Wildlife Refuge (WCA1). Nutrient induced biological changes to the Water Conservation Areas which have been documented to date in the scientific literature are summarized in Table 4. In summary, the impacted marsh ecosystem has changed toward a less healthy, low diversity, heterotrophic system. These changes constitute an imbalance in natural populations of aquatic flora and fauna. This is a violation of Florida water quality standards for the Everglades Water Conservation Areas. The fate of this increased nutrient supply is poorly understood, but Gordon, et. al (1986) found that in Everglades peat sediments only 15% of added nitrate was removed from the system by denitrification, with the rest remaining in some other form and possibly further altering marsh sediment-water nutrient processes.

THE INTERIM ACTION PLAN

The South Florida Water Management District adopted the Interim Action Plan in 1979. This is a management strategy that calls for minimizing the backpumping of nutrient-rich water from the Everglades Agricultural Area north to the Lake. Out of concern for the eutrophic condition in Lake Okeechobee, nutrient-rich water from the EAA is kept out of the Lake and sent south toward the Water Conservation Areas and Everglades National Park. A technical committee (LOTAC I) formed to help solve Lake Okeechobee's eutrophication dilemma recommended in late 1986 continuation of this plan indefinitely. This interim plan has become a long-term management strategy. From 1979 - 1986 this strategy diverted 10,200 tons of nitrogen and 258 tons of phosphorus from the Lake south toward the WCAs and ENP. This represents a 17% increase in phosphorus loading and a 30% increase in nitrogen loading southward since 1973-1978 (SFWMD, September 1987 Board Meeting).

NUTRIENT DOSING RESEARCH

Concern about possible nutrient loading increases to ENP and resulting biological changes led the park to conduct an extensive 18-month field study in 1983 and 1984 to determine the

Table 4. Nutrient-induced biological changes to Everglades Water Conservation Area marshes documented to date in the scientific literature.

PERIPHYTON
-DECREASE IN SPECIES DIVERSITY
-SHIFT TOWARD POLLUTANT TOLERANT SPECIES
-SHIFT TOWARD OXYGEN CONSUMING
(HETEROTROPHIC) ALGAE

MACROPHYTES
-CHANGE IN COMMUNITY COMPOSITION FROM
SAWGRASS TOWARD CATTAIL
(6000 ACRES 1979 TO 20,000 ACRES 1986)
-CATTAIL DECOMPOSITION/PRODUCTION
MORE RAPID THAN SAWGRASS

DISSOLVED OXYGEN
-ELIMINATION OF STRONG DIEL FLUCTUATIONS SUCH
THAT MID-DAY D.O. IS NEARLY UNDETECTABLE

BACTERIA (DECOMPOSITION)
-SHIFT TOWARD AN ANAEROBIC COMMUNITY

MACROINVERTEBRATES
-DECREASED ABUNDANCE
-DECREASED DIVERSITY
-NEAR ELIMINATION OF GASTROPODS
-INCREASE IN POLLUTANT TOLERANT ANNELIDS

NUTRIENT FRONT IS SPREADING

SUMMARY- INDICATIONS ARE THE IMPACTED MARSH ECOSYSTEM HAS CHANGED TOWARD A LESS HEALTHY, LOW DIVERSITY, HETEROTROPHIC SYSTEM

impact of increased nitrogen and phosphorus loading on the marsh ecosystem. A complete description of this study is in Flora, et. al (1986, 1988) and Walker, et. al (1988). Study objectives included: 1) determine the impact on water quality of increased nutrient loading to the Shark Slough marsh within the park; 2) determine the impact of increased nitrate and phosphate levels on algae and aquatic plant productivity, biomass, and community composition; 3) isolate the effects of nitrate versus the effects of phosphate; and 4) gain a better understanding of the marsh's ability to assimilate nutrients, the biological consequences of this assimilation, and the downstream extent of nutrient-induced changes.

Methods

Three flow-through channels, open at both ends and oriented with the direction of flow, were constructed in the Shark Slough marsh within the park (Figure 4). Each channel measured 5 meters by 100 meters and was constructed of 1.5 millimeter thick fiberglass sheets over 1 meter high and sunk about 15 centimeters into the peat sediment. Nutrient additions were made at the upstream end of each channel by means of continuous dosing pumps that delivered known nutrient concentrations into four delivery tubes spaced about 1 meter apart across each experimental channel. These pumps delivered a pulse of nutrients every few seconds. This design allowed controlled nutrient dosing while maintaining the natural Everglades sheet flow environment. One channel (channel B) was continuously dosed with dissolved phosphate and dissolved nitrate from April 1983 through September 1984. For the duration of the study nutrient addition to this channel averaged 28 ppb phosphate and 85 ppb nitrate. A second channel (A) was dosed continuously from October 1983 through September 1984 with only phosphate, at an average concentration of 27 ppb. A third channel (C) was dosed with only nitrate for the same time period at an average concentration of 85 ppb. The open marsh area adjacent to the study site served as the control area.

Water depth, water temperature, water conductivity and solar radiation were continuously monitored at the study site. Discharge through each channel was periodically measured. Water chemistry determinations were regularly made in each channel at 0, 10, 20, 35, 65, and 95 meters downstream from the point of nutrient addition and in the control area. Parameters measured included dissolved phosphate, nitrate, ammonia, nitrite, organic nitrogen, total nitrogen, total phosphorus, alkalinity, pH, and dissolved oxygen.

A number of measures of biological productivity were also made in order to track the biological response to nutrient addition. Macrophyte (rooted aquatic plant) chemical composition and community species composition were determined before and after nutrient dosing. Productivity measurements of periphyton growing on glass slides located throughout the channels were made every six to seven weeks. These measurements included determination of chlorophyll a, dry weight, carbon 14 (radioactive tracer) uptake, and community species composition. In addition, a series of diel water column dissolved oxygen nitrate down channel in the channel receiving nitrate only, while there was uptake of nitrate in the channel dosed with nitrate plus phosphate.

Changes in bacterial decomposition and water dissolved oxygen concentrations were also documented with nutrient addition. Maltby (1985) found that cellulose decomposition significantly increased throughout the water column in response to phosphate plus nitrate addition and phosphate only addition, with the greatest bacterial activity occurring near the water-sediment interface at locations closest to the point of nutrient addition. Scheidt, et al. (1985) found a broader diel dissolved oxygen cycle in the channels receiving phosphate additions and a narrower diel cycle in the nitrate only dosed channel, relative to the control channel. These documented nutrient-induced changes are summarized in Table 6.

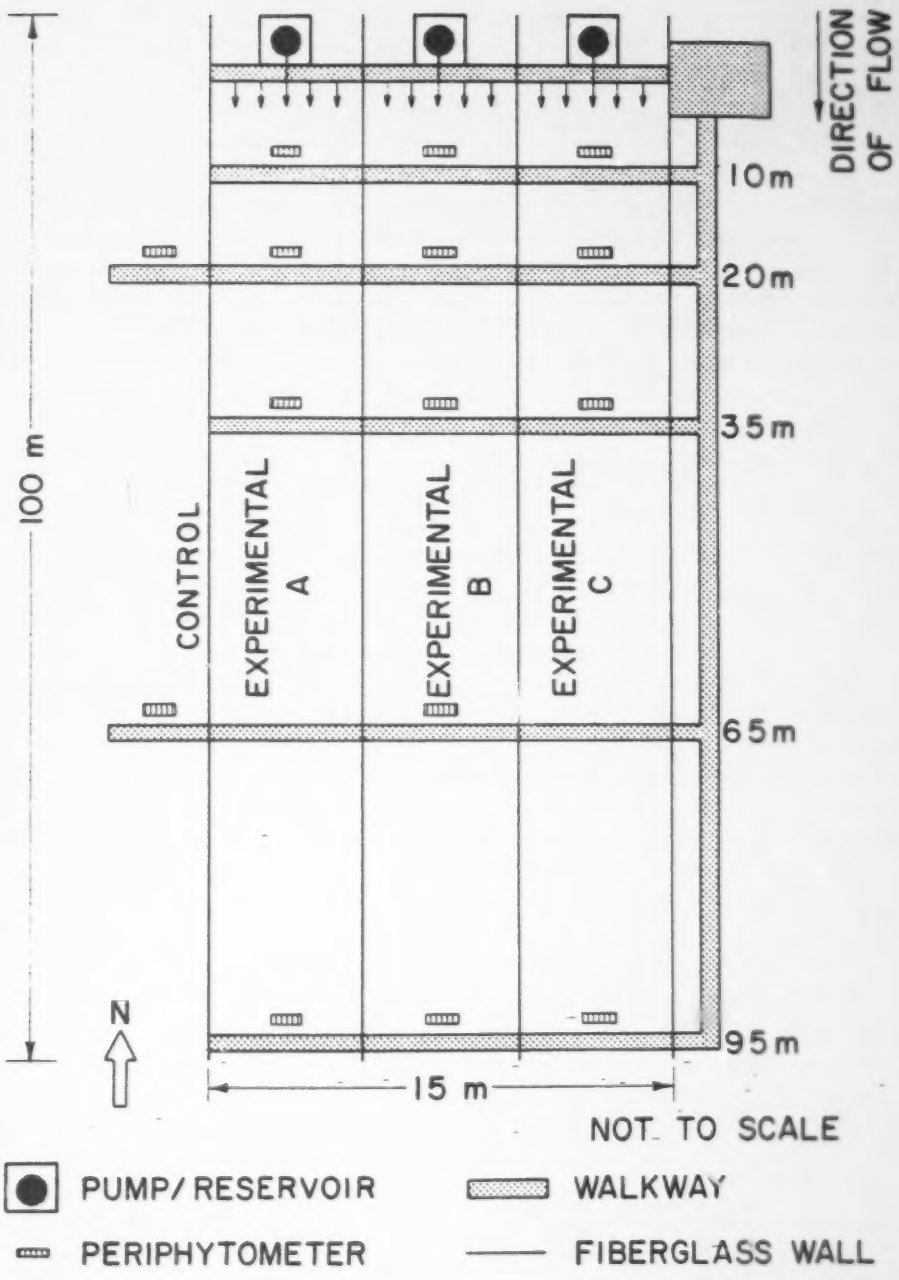

Figure 4. Design for nutrient dosing study field apparatus.

and pH studies were conducted (Scheidt, et. al, 1985), as were studies of decomposition in the water column and submerged peat (Maltby, 1985).

Results

During this study, background dissolved phosphate concentration in the control area averaged 6 ppb. Background dissolved nitrate concentration averaged 11 ppb. Channel B was dosed for 18 months with an average of 28 ppb phosphate and 85 ppb nitrate, resulting in a total concentration of 34 ppb phosphate and 96 ppb nitrate. Similarly, phosphate only was added for 12 months to channel A resulting in an average total concentration of 33 ppb, and nitrate only was added to channel C resulting in an average nitrate concentration of 96 ppb.

The response of the algae and macrophyte assemblages to nutrient addition was rapid and dramatic. In both channels receiving phosphate addition, within eight weeks of the onset of dosing the native blue-green algae/diatom dominated periphyton mat disappeared and was then replaced by a different algal community dominated by more pollutant tolerant species (green algae and different blue-green algae). This native periphyton mat is a conspicuous feature of the Everglades marsh system. This periphyton community serves a number of important roles in the marsh system (Table 5). Such large-scale changes in the periphyton community would predictably affect the performance of these various roles. A 10-fold to 15-fold increase in periphyton biomass resulted, as measured by dry weight and chlorophyll a. The second major response observed was in the macrophyte community. The pre-dosing assemblage was dominated by *Eleocharis* sp. (Spikerush) and *Utricularia* spp. (Bladderwort). Post-dosing the assemblage was different. At the upstream end of the channel receiving nitrate and phosphate addition, the assemblage shifted to one dominated by *Sagittaria* sp. (Arrowhead) and *Panicum* sp. (Maidencane). At the other locations receiving phosphate there was an increase in *Eleocharis* sp. relative to other species. The phosphorus content of live plants increased, and N:P ratio was decreased. Linear regression analysis of water chemistry data indicated that in both channels dosed with phosphate, there was significant uptake of phosphate from the water proceeding downstream from the point of nutrient addition. There was not significant uptake of total phosphorus from these same channels.

The response of the biological community to nitrate addition was more subtle than that observed for phosphate addition. In the channel receiving nitrate only, the native periphyton mat disappeared as well, although only after about eight months of dosing as compared to about two months for phosphate only dosing. Periphyton productivity determinations indicated a slight decrease in biomass as measured by chlorophyll a. Changes in the macrophyte community were also observed. The post-dosing assemblage shifted from an *Eleocharis/Utricularia* dominated community to one where *Eleocharis* sp. became the most dominant. Linear regression analysis of water chemistry measurements indicated no uptake of

Table 5. Roles of periphyton in the Everglades marsh.

- **Periphyton photosynthesis and respiration influence marsh water chemistry (Diurnal pH, Diurnal Dissolved Oxygen, Diurnal Carbon Dioxide, Diurnal Calcium).**
- **Important in marsh nutrient uptake and cycling processes.**
- **Important in calcium carbonate (marl) deposition processes and soil building.**
- **Provide microhabitat within which eggs of some aquatic animals can survive seasonal drought.**
- **A major role in marsh primary production.**
- **A role in marsh detrital processes.**
- **A contributor to aquatic food webs.**
- **Provide feeding habitat and cover for fishes and invertebrates.**

Table 6. Results of the Everglades National Park nutrient dosing study.

ENP NUTRIENT DOSING STUDY RESULTS

PHOSPHATE

PERIPHYTON
-LOSS OF NATIVE MAT
-CHANGE IN COMMUNITY STRUCTURE TOWARD POLLUTANT-TOLERANT SPECIES
-10X - 15X INCREASE IN PRODUCTIVITY/BIOMASS

MACROPHYTES
-SHIFT IN DOMINANT SPECIES
-DECREASE IN N:P RATIO
-INCREASE IN P CONTENT

BACTERIA (DECOMPOSITION)
-INCREASE IN DECOMPOSITION IN SEDIMENT

DISSOLVED OXYGEN
-CHANGE IN DIEL CYCLE

ENP PHOSPHATE STANDARD (20 ppb) IS QUESTIONABLE FOR PROTECTING THE PARK MARSH RESOURCE.

ENP NUTRIENT DOSING STUDY RESULTS

NITRATE

NITRATE ALONE CAUSED BIOLOGICAL CHANGES IN THE MARSH.

PERIPHYTON
-LOSS OF NATIVE MAT
-SLIGHT DECREASE IN PRODUCTIVITY/BIOMASS

MACROPHYTES
-SHIFT IN COMMUNITY STRUCTURE
-DECREASE IN N:P RATIO
-SLIGHT INCREASE IN N CONTENT

DISSOLVED OXYGEN
-CHANGE IN DIEL CYCLE

ENP NITRATE STANDARD (700 ppb) IS INADEQUATE FOR PROTECTING THE PARK MARSH RESOURCE.

Conclusions

1) Changes in the algal community species composition occurred within eight weeks of dosing phosphate only, and phosphate plus nitrate. The native periphyton mat disappeared, and more pollutant tolerant species became dominant. The phosphate levels causing these changes (33 ppb) were about 5 times above marsh background, but less than one-third of levels in Lake Okeechobee, or those entering the WCAs from the EAA;

2) A 10-fold to 15-fold increase in periphyton biomass, as measured by chlorophyll a and dry weight, was observed with phosphate only, and nitrate plus phosphate addition;

3) Macrophyte community composition was changed with nitrate plus phosphate addition from one dominated by *Eleocharis* sp./*Utricularia* spp. to one dominated by *Panicum* sp. /*Sagittaria* sp. The phosphorus content of live plants increased and the N:P ratio decreased;

4) There was significant uptake of dissolved phosphate from the water column downstream in the channels dosed with phosphate only, and phosphate plus nitrate;

5) The native periphyton mat disappeared at about eight months of dosing in the channel receiving only nitrate. The nitrate levels causing these changes (96 ppb) were 9 times background, but less that one-twentieth of concentrations presently entering the Water Conservation Areas from the EAA;

6) A statistically significant but slight decrease in periphyton biomass was observed in the channel dosed with only nitrate;

7) A macrophyte that was dominant pre-dosing, *Utricularia*, was virtually eliminated in all dosing situations (nitrate only, phosphate only, and phosphate plus nitrate);

8) Phosphate is the limiting nutrient in this *Eleocharis* wet prairie. However, increases in nitrate alone also resulted in biological changes, although the changes were more subtle and the nitrate levels dosed were higher than the phosphate levels dosed;

9) The present park water quality standard for soluble nitrate (700 ppb) is inadequate for protecting this delicate marsh ecosystem, and the soluble phosphate standard (20 ppb) is questionable.

10) The dosed phosphate and nitrate levels that caused these biological changes within Everglades National Park are much less than present average levels consistently entering the Water Conservation Areas from the EAA (one-third of phosphate levels, one-twentieth of nitrate levels, Table 3). The dosed nitrate levels are less than levels already entering Everglades National Park at S-12D.

SUMMARY

Managers at Everglades National Park have undertaken a number of initiatives to assure that the water delivered to the park is of sufficient quality to prevent degradation of this ecologically sensitive resource. These initiatives include developing water quality standards for park delivery water, establishing long-term monitoring programs at key water delivery sites and at freshwater marsh sites within the park, and conducting research on the effects of increased nutrient loading on the marsh system. Water in the freshwater marsh within the park is pristine with regard to nutrient concentrations. However, results from the nutrient dosing study indicate that if waters containing nutrients at levels present today in Lake Okeechobee, the EAA, or the northern Water Conservation Areas reach Everglades National Park, major changes in the park resource can be expected at the periphyton and macrophyte levels. These changes may have far-reaching consequences to higher trophic levels and the ecological balance of this delicate marsh ecosystem. Numerous nutrient-induced biological changes have already been documented in the marshes of WCA2A and WCA1 due to EAA runoff. There are many Everglades system nutrient impact unknowns. These include the long-term biological consequences of this nutrient loading to Everglades National Park and the Water Conservation Areas, the rate of movement toward the park, the reversibility of these biological changes, the loading or assimilative capacity of the Water Conservation Area marshes and their effectiveness as a buffer for the park, and basic Everglades nutrient cycling processes (water - soil - biota). Waters passing through the WCA marshes before reaching the park are cleansed of nutrients, while waters shunted down the Miami Canal and L-67A canal to the park are degraded in terms of nitrate and occasionally phosphate. The WCAs are presently serving as the park's water quality buffers, at the cost of extensive biological change to these areas. This is a violation of Florida water quality standards. Such nutrient-induced changes to Everglades National Park would violate both the intent of the U. S. Congress in establishing Everglades National Park and the legislative mandate of the National Park Service:

Everglades National Park Authorization Act of May 30, 1934 (16 USC 410c):

> The said area shall "be permanently reserved as a wilderness" and no development of the project or plan..."shall be undertaken which will interfere with preservation intact of the unique flora and fauna and the essential primative natural conditions now prevailing in this area."

National Park Service Organic Act, (role of the NPS), 1916:

> "which purpose is to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

Senate Report 91-895, P. 24 accompanying PL 91-282 (1970):

> Directed USACOE/NPS to take measures to "assure that the water delivered to the Park is of sufficient purity to prevent ecological damage or deterioration of the Park's environment."

Senate Report 96-416, P. 171 accompanying PL 96-487 (1980):

> "The National Park System concept requires implementation of management policies which strive to maintain the natural abundance, behavior, diversity, and ecological integrity of native animals as part of their ecosystems and the committee intends that the concept be maintained."

Public Law 95-250, 16 U. S. C. 1a-1 (1978):

> "Congress further reaffirms, declares, and directs that the promotion and regulation of the various areas of the National Park System, as defined in section 1c of this title, shall be consistent with and founded in the purpose established by section 1 of this title, to the common benefit of all the people of the United States. The authorization of activities shall be construed and the protection, management, and administration of these areas shall be conducted in the light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress."

Florida Surface Water Improvement and Management (SWIM) Act June 4, 1987. Section 6.(2).a.1:

> "The South Florida Water Management District shall not divert waters to the Indian River estuary, the Caloosahatchee River or its estuary, or the Everglades National Park in such a way that the state water quality standards are violated, that the nutrients in such diverted waters adversely affect indiginous vegetation communities or wildlife,..."

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Mr. NOWAK. I would like to call now our citizen and environmentalists panel together if they would. Representing the Sierra Club, Ms. Theresa Woody, who is Associate Field Representative, and Southeast Region and Broward County Environmental Coalition, who is represented by their Coordinator Ms. Brenda Marinace. We also have on this panel Mr. Joseph E. Podgor, Jr. who is representing Friends of the Everglades, and I take that is a not-for-profit organization, is that correct?

Mr. PODGOR. Yes.

Mr. NOWAK. We will first hear from Theresa Woody.

TESTIMONY OF THERESA WOODY, ASSOCIATE FIELD REPRESENTATIVE, SOUTHEASTERN REGION, SIERRA CLUB; BRENDA MARINACE, COORDINATOR, BROWARD COUNTY ENVIRONMENTAL COALITION AND JOSEPH E. PODGOR, JR., FRIENDS OF THE EVERGLADES

Ms. WOODY. Good afternoon and welcome to south Florida. Mr. Chairman, I am Theresa Woody, Southeast Region Associate Field Representative for the Sierra Club. I want to thank the Subcommittee on Water Resources of the Committee on Public Works and Transportation for the opportunity to present testimony here today.

I am glad that the members had the opportunity to fly over the area and I think you will agree that this system encompasses a region so extensive and so varied that its essence cannot be captured in a single glimpse. It is the shallow pale blue waters of Florida Bay; it is the dense trees along the coastal creeks; it is the flowing expanse of grass that resembles nothing so much as a vast African savanna; it is pines and mangroves and shelly beaches and swamp.

The Everglades is a low place in a low land. The highest elevation in Florida is 345 feet above sea level in the Florida panhandle. Starting at the headwaters of the Everglades, the Kissimmee River, located south of Orlando, the glades run over 150 miles from the Kissimmee to Lake Okeechobee to Florida at the southern tip of the park. The 1.4 million acres of Everglades National Park, covering about one-seventh of the Everglades at its southern most end ranges from sea level to a high of 20 feet on an Indian-made mound near Caloosahatchee—I can hardly say that. [Laughter.]

Prior to the 20th century, the Everglades was only lightly touched by the presence of man. In the early 20th century, Napoleon Bonaparte Broward, in whose namesake county we sit, began to advocate draining the glades. This campaign was to bring about a far greater manmade change in the Everglades environment than anything happening either before or since to this system. In the spring of 1906, the first canal was cut through from the Atlantic to Lake Okeechobee and then the push was on to claim land for development and agriculture.

Some of the land south of Lake Okeechobee did become available for farming, as we have discussed today. But two hurricanes, one in 1926 and the other in 1928, swept over the muck dike that had been built around the lake. Those tragedies led to the involvement

of the Federal Government in this system, and in 1930, the Army Corps of Engineers built the Hoover Dike around the lake.

Drainage and canal-building went on, but the dream of new land became a nightmare of problems. Without its usual protective layer of water, the organic soil of the Everglades oxidized away. Saltwater began to intrude into the Biscayne Aquifer because the head of fresh water in the Everglades which kept the saltwater out, was much receded.

1947 was another landmark year for the Kissimmee-Okeechobee-Everglades system. Okeechobee suffered a severe hurricane that tested the strength of the Hoover Dike. The dike held. It was also the year that President Harry S. Truman established Everglades National Park. Finally, the Everglades role in south Florida was being recognized.

Water delivery in south Florida is rainfall driven, as you have heard today. The less surface water extant, the possibility of drought increases. The Park suffered after open culverts under the Tamiami Trail were replaced by floodgates, several years passed when Shark River slough received no water overland. Finally, Congress had to step in to guarantee a minimum flow of water into the park.

1971 marked another important year for the system, and this was the year that the Army Corps of Engineers finished channelizing the Kissimmee River, $31 million was spent to channelize this river.

Some background on the Kissimmee, 25 lakes for the headwaters of Florida's Kissimmee. The river flows southward, linking Lake Kissimmee to Lake Okeechobee, it supplies 30 percent of Lake Okeechobee's water and it is an important part of the whole watershed. This interconnected system recharges the Biscayne Aquifer, the water supply for nearly 4 million people in south Florida. It also creates a vast watery wilderness supporting fish, wildlife and the unique habitat of Everglades National Park.

In the 1960's the Corps of Engineers began a project to improve flood control, transportation and navigation on the river. In a 9-year period, a little over $31 million was spent straightening and deepening the river bed. The 98-mile long marsh-clad river that had gently meandered through central Florida, home to numerous waterfowl and fish, was transformed into a 52-mile long, 200-feet wide, 30-feet deep ditch. The beautiful Kissimmee River was now Canal C–38.

The result of this, while many people anticipated the channelization of the river would reduce fish and wildlife populations, few realized the project's effect on the Region's water quality and quantity. Before channelization, heavy rainfall caused the basin lakes and rivers to rise, flooding adjoining marshes. The surrounding marshes served as a natural filter, absorbing phosphates and nitrates and holding large volumes of stormwater.

But after the project, water drained from the valley 11 times faster. Almost 200,000 acres of marshlands and wetlands were lost. Ninety percent of the waterfowl left the area. The natural wetland filter and storage area was destroyed.

Now phosphates and nitrates flow directly into the canal. The canal feeds these into Lake Okeechobee and eventually the Ever-

glades. Wildlife, fish and water quality suffer as these pollutants invade the waterways.

Now that the consequences of this project are becoming evident, a movement is underway to restore this river. In 1984, the South Florida Water Management District began a three-step project to revitalize a small section of the Kissimmee. I hope that your fly-over today might have included that section. This marks the first time an attempt has been made to alter a public works project because of devastating environmental damage.

Restoration will return flow to parts of the old river, restore natural water level fluctuations and reflood about 12 miles of the original marsh flood plain.

The benefits anticipated to this project will be recharging the aquifer, increasing water storage in that area, reducing the water flow into Lake Okeechobee during the rainy season, enhancing habitat to support wildlife and fish and finally, improved water quality.

The Kissimmee is a vital part of the unique ecosystem of Florida. The river has been damaged by channelization. Adjacent wetlands and Lake Okeechobee are being destroyed. Water quality is deteriorating. The drinking water supply may soon become limited. The river is a link to the Everglades, a national treasure that must be protected.

Currently, the Sierra Club and the Everglades Coalition are working to secure federal moneys to mitigate this environmental damage to the headwaters of the Everglades. We have this Subcommittee on Water Resources to thank for providing the vehicle to secure those dollars. Section 1135 of the Water Resources Development Act of 1986 authorizes the Army Corps of Engineers to carry out a demonstration project on existing works to improve the quality of the environment in the public interest.

The Kissimmee River is a prime candidate for section 1135 moneys. The fiscal year 1989 budget recommendation for Public Works of the U.S. House of Representatives includes $300,000 for the Kissimmee. The fiscal year 1988 budget authorized $2 million for the river, but that money was never released to the Corps.

Section 1135 offers an historic opportunity for the Corps of Engineers to revisit existing projects and modify them if appropriate. However, this authorization expires November 30, 1988, as the original version called for a report by the Secretary of the Army to the Congress on the state of the program. The Secretary is responsible for recommending modifications or extension of the program.

Section 1135 is applicable to a number of existing projects nationwide, from the Kissimmee to the Louisiana delta and many others. There is a bill in the Senate, S. 2100 which reauthorizes this provision for 5 more years. This committee should support a similar bill in the House.

Let us continue to learn from the past.

Mr. NOWAK. Thank you very much, Ms. Woody.

We will have the testimony now I think of Brenda Marinace and then we will have the testimony of Mr. Podgor.

Ms. MARINACE. Thank you very much. I did hand in copies of my report earlier and I will attempt to just summarize and perhaps add some other details instead of reading the entire report.

Mr. NOWAK. Very good.

Ms. MARINACE. Our organization, the Environmental Coalition has recently expanded to the Environmental Coalition of Florida, but I am here today representing the Broward County branch.

The Environmental Coalition of Broward County began 10 years ago and almost immediately became concerned with a portion of the Everglades system which is located in Broward County basically known as the western C–9 basin, and is located just east of the levee and west of the recently constructed Interstate 75 in the southwestern portion of the supposedly developable portion of Broward.

The early interest that we had in this was the construction or the proposed construction of Interstate 75 through the area. We initially joined in with the Florida Wildlife Federation and National Wildlife Federation to attempt to stop the construction of that highway, and ultimately to have it redesigned so that it would not access the area with a lot of interchanges which would promote development in this area. Unfortunately this was not successful. For a short period of time several of the interchanges were stopped and then ultimately the County Commission took a vote to put those interchanges back in again. We were told at the time by Federal agencies that the primary concern in the western C–9 basin would be ultimate development which would be attracted by the interstate, and we were further told that we would have to hold development locally. We are now faced with that today.

Taking a look at the C–9 basin, it originally was part of the flood plain of the Everglades system prior to drainage and it served to recharge the Biscayne Aquifer. It also served as a resource to wildlife, especially wading birds in that area.

Today its function is relatively unknown. We have a report from 1976 by the South Florida Water Management District which concluded then that it was a floodway, it collected rainwater, especially collecting water that would have sat in the eastern areas which were higher elevations, serving as flood control for these areas, and then eventually using that water to recharge the aquifer.

The Water Management District also reported that there was considerable seepage from the conservation area which is just west of this, across U.S. Highway 27, with a flow going in an east-southeast direction the waters would run into this western C–9 basin and further serve to recharge the aquifer. They were concerned that there would be easy escapes from the conservation area that would be created by excess drainage that would be applied to the C–9 basin. They stated that there should be limits to development ten years ago, however there were only basic studies conducted at that time.

In 1979, a one in 100 year flood occurred in Broward County and the South Florida Water Management District again put out a report that said that basically the western C–9 basin is prone to flooding, that it is inherent in the system out there and that it constantly floods with storms of even less intensity.

What we know at this point is that the system was basically still working 10 years ago, it was still serving to provide flood control for other areas and it was serving as a recharge into the aquifer water supply. What we have today is an example of an ecosystem

that is sitting in limbo. It is east of the dike, and this was a political decision, an arbitrary decision that was made at the time they were attempting to put flood control in.

Because of the fact that it is east of the dike, it has been assumed that it would be available for some sort of development. However, there have been no studies to determine what effect this has on the system at large. Just because it is east of the dike does not mean that it has been removed from the system.

The Interstate 75 construction, with its ultimate interchanges, has put intense pressure on this area for development. In spite of the fact that we have this intense pressure out there, we have not had any studies to determine what it contributes to the system. We are still faced with individual permit review and we are still faced with general ignorance of what that area actually does.

We are concerned that this might be the last straw on the proverbial camel's back. There may be a lot of these areas sitting around the State of Florida or the southern part of the state along this system.

What we recommend and what we feel needs to be done is a cumulative impact study of the area so that we can know what we have as a base line before we go ahead and determine that we can go ahead and continue to destroy the wetlands in south Florida. We know now that we need to have our wetlands. That has been determined some years ago, and there have been numerous attempts at saving the wetlands. In spite of this fact, with over 50 percent of the Nation's wetlands found in the southeastern part of the Nation, we have sustained 84 percent loss. We do not seem to be getting a handle on stopping the destruction of our wetlands in spite of the fact that we know they need to be saved.

What we have in south Florida is a remnant system that now must process more water than ever for human uses and still be able to provide for the Everglades National Park at the bottom end.

We have heard numerous discussions today about the loss of wading birds. As an example of what has been happening in south Florida with the individual permit review that we have, I would like to just address the wood stork in general. The wood storks have decreased, as I knew with my data, over 80 percent—I heard today over 90 percent. In 1982 it was 80 percent, so we have lost another 10 percent of our wood storks in another 6 years. They have only managed two successful nesting periods in 18 years. In spite of this fact, when individual permits for wetland destruction or wetland dredge and fill are requested, the wood storks are still being ignored, even though they use an area we are told that this one habitat is not going to be the last straw, it is not going to be the one that is going to do in the wood stork. The same is true of the Everglades kite, the same is true of the Florida manatee and the list goes on.

The signs are here and we have discussed them all today, but we still have not done the studies and we still have not stopped the loss. We feel that there should be an assessment of the efficiency of the permitting process. We seem to have a proliferation of agencies who are talking about the problem on all levels, from local, region-

al, State and Federal; but we also still continue to lose our wetlands and practically no attempt to stop any of the destruction.

In the southwest Broward area in the western C-9 basin, we are faced with a landfill, a raw garbage landfill. We have heard numerous discussions also on how bad landfills are. And compounding that by putting it on top of a functioning wetland does not seem to make a lot of sense, but the decision is being made at this time and the decision is being made only on the concerns of that one area and the needs of the county, not the needs of the system.

We also have right now before us the request for 2,500 acres of that area being turned into intensive housing. The first initial impact that came out of the Army Corps of Engineers was that they were not even going to ask for an environmental impact statement. An environmental impact statement would be the very least that we could do to make some determinations on that area; however, it would not be sufficient because it would only consider the impacts of that one development and that one area. It still would not be looking at the cumulative impact.

Florida needs to protect and manage the wetlands it has left and it can only do this with adequate knowledge and understanding of the system. It needs to stop the loss and it needs to repair and upgrade the systems that it has left.

Environmentalists continually have to attend hearings of all levels of all of the agencies that have appeared here today talking about our loss in wetlands, and environmentalists are the ones that have to demand that we stop the loss of the wetlands. We routinely lose.

Of utmost importance in this process we believe is the fact that future decisions regarding wetland systems must be based on what will happen to that system, not what will happen to the applicant.

Thank you very much.

Mr. NOWAK. Thank you very much.

We will now hear from Joseph Podgor. Joe, we have your testimony and it will be incorporated in the record.

Mr. PODGOR. Thank you, Mr. Chairman, I apologize for not having that to you in time for a more thorough review prior to this time. I will try to keep my remarks to a summary of that rather than reading from it.

First of all, I would like to just let you know that our organization is a statewide group with approximately 3,600 members, it has also been found in some 30 odd other states and a few foreign countries. Our president is Marjory Stoneman Douglas, who wrote a very good book on the Everglades system called "The Everglades River Grass," and I think we can boast of having one of the longest views on this problem of any organization or institution in existence in that Marjory Douglas has been on the scene and dealing with it for nearly 90 years. Some people say she invented the Everglades, but we are not going to put that one on her.

I would like to confine my remarks to those portions of my testimony that deal with four major divisions. Among our views we have an unusual viewpoint, it is a luxury for us, we are not an agency or branch of Government. We do not have a lot to lose by saying unpopular things. We do not have to pussy-foot around frequently because of getting in the way of a hierarchy that would

later snub us in some later event. As a result, we frequently see this in a different way from much of the testimony you hear. We see much of the problem, not only in the practices of ignorance in the past, but also the practices of the present as operated by folks who are actively engaged in trying to solve the problem. These areas would be the permitting area for wetland filling, the area dealing with pollution control in this southern Florida regional watershed, the management of water—the physical management of the water in the area, and the issues that are surrounding the drinking water question. These four areas have to be uniquely addressed in a group.

I would like to take them in line and just leave you with a few comments on each.

The permitting of wetlands is a process that Congress set up and we are grateful for that, beginning in 1970 through the Pollution Control Act and the object we understand it to mean was that a concern was identified that wetlands were valuable to the public and they were being lost at at alarming rate, that they served as not only a public benefit but as a national resource of the first order. And so a process was put together to prevent the loss of those wetlands.

That permitting process given to the Army Corps of Engineers with advice from many agencies, has been the primary method that the federal role has played in dealing with that. And it has been undercut by guidelines produced by the Army Corps of Engineers on how they will operate this permitting program, and in particular how those guidelines are applied in our region, as how it affects this particular resource we are looking at.

The Army Corps of Engineers District in Jacksonville, in reports we have reviewed, has one of the worst records in accepting advice from fellow agencies on how their permits should or should not be considered. In terms of wildlife specifically, the U.S. Fish and Wildlife Service's advice has been refused in a majority of the cases in permits during the study period of three years in the early 1980's—late 1970's-early 1980's.

The practice of using mitigation as a means of providing for the public interest in a permit has led to a great number of permits that ordinarily would not be allowed under the general criteria tests that the 404 Section would provide for. It amounts to what we see in many cases as setting aside a portion of a tract, maybe 50 percent of it, to be kept while the other is to be destroyed. This does not meet the national goal of trying to reduce the loss of wetlands. In fact, it allows 50 percent of it to be deliberately, with a permit, destroyed. It is like cutting the baby, only this time you throw away half and you say the other half will lead a long and productive life. Solomon refused to do it, but the Corps has no problem with that.

After-the-fact enforcement. We find that in our south Florida experience, many such permits of major projects are most easily accomplished if you just go ahead and break the law and get a permit from the Army Corps of Engineers after the fact. The penalties are small compared to the profits that can be had. It is a standard practice, it has only occasionally been nipped by a judicial order. One case in particular, Judge Merton's order in a case in the Keys

where he asked to restore an entire mangrove area that had been taken down without a permit. But most of them are actually given the permit after a certain amount of negotiation.

The Army Corps of Engineers and the Environmental Protection Agency loathe environmental impact statements, and yet we see this as a fundamental basis of our environmental policy, to make decisions based on knowledge which in turn comes from observable data. In major federal actions, the permitting of vast areas of wetlands concurrently to be filled in certain critical areas of our east Everglades areas, for example, we believe to be major federal actions and yet routinely these agencies have refused to deal with environmental impact statements.

Other examples are, the largest single wellfield in the state, the northwest wellfield in Dade County, an environmental impact statement for some 1500 acres of concurrently pending applications for wetland fill in the drawdown area of that wellfield were denied by both EPA and the Corps.

Silver Lakes, 4 square miles, at this point this is a wetland area in the western part of Broward County, 2300 acres of wetlands, no EIS coming from the Corps and denied as a request.

A big dump in the same general vicinity of the western area, this is the recharge area upstream from the water supplies in that county; again, denied.

There is the phenomenon of national permits which allows, without any public hearing, public comment period or any kind of public notice, the filling of 10 acres or less of wetlands in the Nation. This, in this particular area with the pressure for development, comes when the cheaper wetlands is boom, a landslide, and a terrible accelerator of conversion of wetlands into urban development.

The notion of a general permit incorporated in 404 is to allow minor implications—minor impacts on the environment to be given a general permit so as to streamline the permitting process. The Jacksonville District is currently attempting to apply that to 3 square miles of wetlands on a concurrent site being studied for one of the major water supply wellfields for Dade County. They feel that by mitigating that, by purchasing a piece of wetland in existence offsite, that may mollify the so-called generally large nature of that general permit and allow it to be considered so insignificant as to come under the general permit requirements. We feel that this type of contrivance is not meeting the mission that the law that Congress sent down required.

To the pollution control aspect of this question, we have an NPDES program which is to eliminate discharges of pollution, yet there is a myriad of private, commercial discharges of pollution in the farming areas south of Lake Okeechobee. They are not only not permitted by the Federal Government, they are not permitted by the State Government. And yet they are known to the State agencies as being present. They frankly put their hands up in the air and say it is too hot to handle, we will have to deal with it in some general way. There has been a number of efforts to try and inventory them, but it has only scratched the surface. This is in fact waste water or sewerage, if you will, from a commercial enterprise that is being discharged into public waterways and from that point

it has to be distributed to either ruin our Everglades conservation areas, further downstream the park, or to be back pumped uphill into Lake Okeechobee and to add to the loading that we have been so concerned about today.

There is a handle for that, it is not being used.

Mr. SHAW. Could you be specific as to what project you are talking about?

Mr. PODGOR. I am referring to—it is not any one project, Congressman, t has to do with individual farms which you have noted are large, that are free to discharge into drainage system canals which in turn drain into publicly operated canals and they in turn are back pumped or moved downstream.

Most of these discharges are not categorized as NPDES permit candidate, and yet they are under the guidelines that we reviewed. They are a byproduct of a commercial operation, they are not rainwater runoff. This is a washwater for water treatment of the field to prepare the soil which is then drained back off into the public domain after the soil has been prepared.

The requirement of on-site treatment of agricultural wastes is what we see as a solution. These businesses are large corporate members of our communities and they have the same responsibilities that Dow or Monsanto has to deal with their water pollution needs. They should meet the same water quality standards that are required of others and they should be required to have permits so that that can be monitored.

Instead, what we are doing is we are providing living kidneys in the form of our Everglades wetlands and the conservation areas and a variety of other techniques to deal with that problem for them. It is a Federal and a State subsidy of the cost of doing business by these agencies, and this cost is not at all accounted for in the damages that downstream we suffer in these various other systems we have been talking about today. You have class 3 standards that we attempt to reach and in our state class 3 is the swimmable, fishable idea. We are in 1988, we feel that this is the kind of goal that needs to continue to be aimed for. We had from 1972 to 1985 to meet it and we have not come close. Although our State for the last 10 years has declared most of the waterways in our State to be class 3 or swimmable and fishable waterways, they are by no means all swimmable and you dare not eat the fish from the urban waterways that we have where most of the people are.

The concept that I have heard put out that certain pollutants will be absorbed by wetlands between the lake and the park has been talked about a lot today. We have a horrible problem with that. Most of the Everglades does not lie within the boundaries of the park, 80 percent of it is within these water conservation areas. To preserve the system, you do not preserve the tail, you preserve the whole animal. This particular problem will be exacerbated as the contamination, the overloading of nutrients in the lake is then passed on to the conservation areas, and they in turn become in their way eutrophied to produce an excess of contaminants that are moved down line, a domino effect. You cannot rely on these systems to contain forever and filter forever a continuing input of new contaminants.

The question of water management in general, we are in fact over the last 40 years and perhaps even a shorter time when we look at the system that was designed in one year, the Central and Southern Florida Flood Control System, was designed in the course of a year in its initial form and then it has taken all those years in between to try and deal with how to make it work—it is in a way trying to replace a natural system with a bionic substitute, sort of to borrow from the literature or television, like a Stepford wetland. You have a misbehaving natural system, so you put the perfect robot in its place. Only we have not been able to perfect that robot. Most of our environmental organizations in the state have been calling for the years and through the Environmental Coalition in Washington, for a return to naturally driven systems. Now we applaud our state agencies in working with the Corps to try and get rainfall driven models, but we have a long way to go.

The question was asked how long does the lake have before it will turn, before it will die. The architect of the Everglades repair program, which was ultimately involved into Senator Graham—then Governor Graham's Save Our Everglades Program, was a fellow named Arthur Marshall, and he said——

Mr. NOWAK. Just a minute, we have to change the tape——

Mr. PODGOR. I am sorry.

Mr. NOWAK [continuing]. To keep up with you.

[Pause.]

Mr. NOWAK. OK, go ahead.

Mr. PODGOR. Thank you, Mr. Chairman. Please forgive me for talking too quickly. I sometimes find that my northern origins catch up with my southern desire to slow down.

Mr. SHAW. Go south, young man.

Mr. PODGOR. Indeed, Miama.

The point that I was reaching at that last juncture was that we were looking at a prediction of how long it was going to take. We have this gentleman I mentioned before, Arthur Marshall, who made a prediction 14 years ago that the lake would be gone in 15 years. He sounded like a fanatic at the earliest moments and when the algae blooms came along, it became a matter of some concern to us that the gentleman is probably on target. We have been studying Lake Okeechobee with grants and studies of a mammoth scale, $2 million at one junction back in the 1970's, for at least 15 years and yet the progress towards its solution has gone no further than the very beginning stages

Here we are almost on the edge of preparing for the funeral while we have just begun the treatment. We have great hope that more can be done, but one of the major concerns we have in the management question is what do you do with the material that is already in the system. And this was raised by members of the Committee before. It is a major concern, this material does not go away. If you cut off what goes into the lake, you still have a big job with dealing with what is already in it. And the question of turning it over during an upheaval of a hurricane is just as real when the lake has received no more input, let alone some 40 percent decline.

Also, there is a matter of the regulation of the water levels in the lake. It has been discussed at great length that perhaps the raising of the water levels in the lake drowned marsh grasses

which then loaded the lake all at once with a great deal of rotting vegetation which made the problem all of a sudden quite worse. The other losses that can be catalogued as a result of changing the lake water levels include all of the things that have to do with wildlife. I am not a wildlife expert. But clearly the question of loading the lake with dying vegetation could kick off an acceleration in the eutrophication cycle is a viable problem and one that has to be addressed, and we do not see that being done even as we speak.

Recent decisions have been made to keep lake levels at a higher level than is a historic need, mostly because of the need to have a reserve supply for agriculture irrigation, rather than to deal with the dying lake in its crisis.

Moving to the drinking water issues, I have the odious distinction of being the fellow who petitioned EPA to get the sole source designation under the Safe Drinking Water Act for the Biscayne Aquifer. We were successful, I with six others, sent the petition in as individuals and we were awarded the pleasure of seeing it be so designated. It is one of the first in the United States, I think it was the fifth one. However, it has yielded nothing except money for studies to agencies and no action. The point to the provision 1424(e) of that act was to give the Federal agency, EPA, a chance to intervene in projects that using Federal assistance may contaminate the aquifer in a way that would create a significant hazard to public health. They refused to do that on every occasion and it has not yet been employed, as I know of, in our State and perhaps only once in the Nation. The cases in particular involve a federally sponsored jetport, some 35 square miles of airport slated to be right in the cone of depression or the drawdown area of the largest well field in Dade County, one of the largest in the United States. EPA refused to even ask for an EIS in that case and certainly did not do a sole source issue there. The same thing with I–75, which is responsible for the decline and fall of the wetlands in western Broward.

The Well Field Protection Plan we had a hand in. It was instigated originally in ordinance form by citizen action in 1975. Groups of mayors approached our county to finally be refused. It was not until I organized a group of some 17 angry citizens organizations that stormed our county commission, that we reversed a plan to do industrial zoning in a wellfield area and come up instead with a major wellfield protection program which is now your model for behavior around the country, the first. We feel it to be completely inadequate, but we also feel that the land use solution is the only solution. If you come up with means of monitoring or permitting pollution sources in the watershed, you will have pollution in the watershed through inadvertent accidents and spills anyway. No amount of monitoring or enforcement or cleanups will reverse the ground water contamination catastrophe. Prevention is the only key.

The new legislation that may come before you at the national level concerning ground water, we feel is the bottom line in water management for the human point of view, not speaking to the ecosystem at this point. We do not have the controls in the sole source provisions, we do not have the controls in the changes to the Drinking Water Act and the other existing legislation that produced wellhead protective measures as an optional thing to be

done, even in sole source areas. They only require plans but not actual implementation.

We cannot as a nation consider ourselves secure from our enemies and secure from ourselves if we do not have secure water supplies that will serve us in peace and in matters of defense, especially in areas where we have sole sources and no alternatives, it is an economic, a defense and a human requirement.

So I urge you all to consider this as you look at this legislation, to be at the top of the agenda for matters of priority in the United States as preparation for its own future.

My other remarks I think will probably speak for themselves and the day is drawing to a close, and I thank you all for your indulgence.

Mr. NOWAK. Thank you for your comments.

[The prepared statements of Ms. Woody, Ms. Marinace, and Mr. Podger follow:]

STATEMENT OF THERESA WOODY

Good afternoon and welcome to South Florida. Mr. Chairman, I am Theresa Woody, Southeast region Associate Field Representative for the Sierra Club. I want to thank the Subcommittee on Water Resources of the Committee on Public Works and Transportation for the opportunity to present testimony on the Kissimmee River-Lake Okeechobee-Everglades ecosystem.

I'm glad that the members had an opportunity to fly over the area. I think you'll agree that this sytem encompasses a region so extensive and so varied that its essance cannot be captured in a single glimpse. It is the shallow pale—blue waters of Florida Bay; it is the dense trees along the coastal creeks; it is a flowing expanse of "grass" that resembles nothing so much as a vast African sawanna; it is pines and mangroves and shelly beaches and swamp.

The Everglades is a low place in a low land. The highest elevation in Florida is 345 feet above sea level in the Florida panhandle. Starting at the headwaters of the Everglades, the Kissimmee River located south of Orlando, the "glades" runs over one hundred and fifty miles from the Kissimmee to Lake Okeechobee to Florida Bay at the southern tip of the park. The 1.4 million acres of Everglades National Park, covering about a seventh of the Everglades at its southernmost end ranges from sea level to twenty feet on an Indian-made mound near Chokoloshee.

Prior to the twentieth century, the Everglades was only lightly touched by the presence of man. In the early twentieth century, Napoleon Bonaparte Broward began to advocate draining the Everglades. This campaign was to bring about a far greater man-made change in the glades environment that anything happening either before or since. In the spring of 1906, the first canal was cut through from the Atlantic to Lake Okeechobee. The push was on to claim land for development and agriculture.

Some land south of Lake Okeechobee did become available for farming. But two hurricanes, one in 1926 and the other in 1928, swept over the muck dike that had been built around the lake. Those tragedies led to the involvement of the federal government, and in 1930 the Army Corps of Engineers built the Hoover Dike around the lake.

Drainage and canal-building went on, but the dream of new land became a nightmare of problems. Without its usual protective layer of water, the organic soil of the Everglades oxidized away. Salt water began to intrude into the Biscayne Aquifer because the head of fresh water in the Everglades which kept the salt water out, was much reduced.

1947 was a landmark year for the Kissimmee-Okeechobee-Everglades system. Okeechobee suffered a severe hurricane that tested the strength of the Hoover Dike. The Dike held. It was also the year that President Harry S. Truman established Everglades National Park. Finally, the Everglades role in South Florida was recognized.

Water delivery in South Florida is rainfall driven. The less surface water extant, the possibility of drought increases. The Park suffered after open culverts under the Tamiami Trail were replaced by floodgates, several years passed when Shark River

slough received no water overland. Finally, Congress had to step in again to guarantee a minimum flow of water into the park.

1971 marked another important year in the Everglades system. This was the year that the Army Corps of Engineers finished channelizing the Kissimmee River. $31 million dollars was spent to channelize the Kissimmee River.

BACKGROUND

Twenty-five lakes form the headwaters of Florida's Kissimmee River. The river flows southward, linking Lake Kissimmee to Lake Okeechobee. Supplying 30% of Lake Okeechobee's water, it is an important part of the Everglades-Lake Okeechobee-Kissimmee River watershed. This interconnected system recharges the Biscayne Aquifer, the water supply for nearly 4 million people in South Florida. It also creates a vast watery wilderness supporting fish, wildlife and the unique habitat of Everglades National Park.

THE TRAGIC BLUNDER

In the 1960's the U.S. Army Corps of Engineers began a project to improve flood control, transportation and navigation on the river. In a nine-year period, $31.6 million was spent straightening and deepening the river bed. The 98-mile-long, marsh-clad river that had gently meandered through Central Florida, home to numerous waterfowl and fish, was transformed into a 52-mile-long, 200-feet-wide, 30-feet deep ditch. The beautiful Kissimmee River was now Canal C-38.

THE RESULT

While many people anticipated the channelization of the river would reduce fish and wildlife populations, few realized the project's effect on the region's water quality and quantity. Before channelization, heavy rainfall caused the basin lakes and river to rise, flooding adjoining marshes. The surrounding marshes served as a natural filter, absorbing phosphates and nitrates and holding large volumes of stormwater.

But after the project, water drained from the valley 11 times faster. Almost 200,000 acres of marches and wetlands were lost. Ninety percent of the waterfowl left the area. The natural wetland filter and storage area was destroyed.

Now phosphates and nitrates flow directly into the canal. The canal feeds these into Lake Okeechobee and the Everglades. Wildlife, fish and water quality suffer as these pollutants invade the waterways.

REPARING THE DAMAGE

Now that the consequences of the 1960's project are becoming evident, a movement is underway to restore the Kissimmee River. In 1984, the South Florida Water Management District began a three-step project to revitalize a small section of the Kissimmee. This marks the first time an attempt has been made to alter a public works project because of devastating environmental damage.

Restoration will return flow to parts of the old river, restore natural water level fluctuations and reflood 12 miles of the original marsh flood plain.

Anticipated benefits of the landmark project are:

recharging the aquifer
increasing water storage in the flood plain
reducing water flow into Lake Okeechobee during the rainy season
enhancing habitat to support wildlife and fish
improving water quality

CONTINUING THE RESTORATION

The Kissimmee is a vital part of the unique ecosystem of Florida. The river has been damaged by channelization. Adjacent wetlands and Lake Okeechobee are being destroyed. Water quality is deteriorating. The drinking water supply may soon become limited. The river is a link to the Everglades, a national treasure that must be protected.

Currently, the Sierra Club and the Everglades Coalition are working to secure federal monies to mitigate this environmental damage to the headwaters of the Everglades. We have the subcommittees on Water Resources to thank for providing the vehicle to secure those dollars. Section 1135 of the Water Resources Development Act of 1986 authorized the Army Corps of Engineers to carry out a demonstration project on existing works to improve the quality of the environment in the public interest.

The Kissimmee River is a candidate for Section 1135 monies. The FY 89 Budget recommendation for Public Works of the U.S. House of Representatives includes $300,000 for the Kissimmee. The FY 88 Budget authorized $2 million for the river, but that money was never released to the Corps.

Section 1135 offers an historic opportunity for the Corps of Engineers to revisit existing projects and modify them if appropriate. However, this authorization expires November 30, 1988 as the original version called for a report by the Secretary of the Army to Congress on the state of the program. The Secretary is responsible for recommending modification or extention of the program.

Section 1135 is applicable to a number of existing projects nationwide, from the Kissimmee to the Louisiana delta and many others. There is a bill in the Senate, S. 2100 which reauthorizes this provision for 5 more years. This committee should support a similar bill in the House.

Let us continue to learn from the past.

STATEMENT OF BRENDA MARINACE, DIRECTOR, ENVIRONMENTAL COALITION OF FLORIDA, INC., ON BEHALF OF THE BROWARD COUNTY BRANCH OFFICE, AS WELL AS THE ENVIRONMENTAL LEADERS COUNCIL

Re Kissimmee River/Lake Okeechobee/Everglades Ecosystem.

Thank you for the opportunity to address your Committee here in Ft. Lauderdale concerning the future of our vast Everglades water supply ecosystem.

The Environmental Coalition has been specifically involved and concerned with a portion of this system in Broward County since our beginnings in 1979. My comments are focused today on this area, which is referred to as the western C-9 basin. This area is just east of the levee, and west of the recently constructed Interstate 75 in the southwestern portion of Broward County.

In terms of water flow, this area was a floodplain of the Everglades system prior to drainage, and as such it served to recharge the Biscayne Aquifer. It served as a resource to wildlife, especially to wading birds, providing historically both a nesting and feeding location, including the now endangered woodstork and Everglades kite.

What function the C-9 basin serves today is relatively unknown. A 1976 report by the South Florida Water Management District concluded that the entire western C9 basin was a floodway, and that because its surface area sits lower than areas to the east, it collected rainwater from the east. This serves two purposes. First, it protected the eastern, developed areas from excessive flooding, and second, it held the rainwaters and slowly allowed them to premeate into the aquifer below and served to recharge that water supply.

The Water Management District also reported that there was considerable seepage from the Conservation Area across U.S. Highway 27 into this basin, flowing in an east-southeast direction. They expressed concern that for conservation of fresh water, we must not create easy escapes from the Conservation areas and that the vehicle for such seepage would be drainage systems created in the C-9 basin. Their belief was that this would increase seepage rates from the Conservation Area. They stated then that development should be limited to agriculture (with limitations related to possible pollution), recreational activities, and certain industrial uses which would not cover over the land area and could accommodate the occasional flooding (especially favored was rock mining).

In 1979 a 1 in 100 year flood occured here in Broward County, and the South Florida Water Management District prepared an assessment following the flood. In addressing this western C-9 basin area, they stated that flooding is inherent in the desing of the system there, and that eastern urbanized areas are essentially served first with excess runoff retained in the west end. They noted that the area commonly floods with storms of much less intensity.

It appears from those reports that 10 years ago, the western C-9 basin area, in spite of drainage and alteration activities, was still serving its function of floodwater collection and subsequent recharge of our aquifer which in that area is close to the surface and sometimes intermixes with surface waters. Added to this is a problem mentioned in the 1979 flood report which states that there is a dense salt water tongue that creeps up the C-9 canal during high tide periods. There is a natural tendency for this to move to the C-9 basin because it is low-lying. therefore the District could not open its control gates on the bottom because it must prevent this saltwater from intruding into our western water supply area. It has to maintain a strong head of freshwater in the canal from the west at all times to keep this saltwater tongue from moving inland.

Today, the western C–9 basin in Broward County sits as an example of an ecosystem on the threshold of being forever altered and destroyed. This area is now under great pressure from development interests because of its proximity to the interstate highway. It does not display a traditional pristine appearance of a wetland on the surface because of groundwater level changes and drainage. Proposals abound to "restore" small portions of the site by scraping down the area and planting wetland vegetation (thus creating the appearance of more pristine wetlands) in return for permission to construct projects on the majority of the area.

No studies of this basin area have, however, been conducted beyond the reports in 1976 and 1979, and these were not conducted to determine the functioning of the area or its relationship to the Everglades system. No one knows what this area contributes to our Everglades system, or how critical the effects will be if it is lost.

This is where we believe the federal government comes into the picture. The Army Corps of Engineers, maintains jurisdiction over these so-called "marginal" wetlands and must determine whether to issue dredge and fill permits to allow development of the area. These decisions up to now are being made with only a minimal amount of data. The federal government was part of the original plan to manage the water in Florida, but the job is only half done.

It is a given that the Everglades has been forever altered and segmented and that we will always have to actively manage the system to provide for both human and wildlife habitation. The unfortunate part of this scenario is that areas such as the C–9 basin may very well be the "last straw" on the proverbial "camel's back", but we are not making critical determinations prior to allowing this alteration and destruction to take place. The fact is that before we choose to forever alter the function in one area of the system, we must seek to understand what the effect will be on the rest of that system.

Cumulative impacts are little understood or addressed. In order to do this, the system's structure and function must be understood. We must explore the relationship between one section of the system and another. According to the participants in a conference held in Sarasota, Florida, in October 1985 ("Managing Cumulative Effects in Florida Wetlands"), "long lag-times between impacts and their expression further complicate detection of cumulative effects." Further, they state, "traditional impact assessments deal with direct consequences of a project but almost never consider secondary impacts." therein lies the problem, and perhaps the solution.

Consider Florida in general. By the mid 1970's, 11 percent (11.3 million acres) of 99 million acres of wetland remaining in the nation were found in Florida. About ½ of the Nation's wetlands are found in the southeastern part of the nation, but this southeastern area accounted for 84 percent of the losses. Florida suffered its greatest losses (74% or over 1 million acres) in palustrine emergent wetlands, which includes freshwater marshes, wet prairies and everglades. The western C–9 basin is, a palustrine emergent wetland.

In spite of the fact that we have learned the critical need to protect our wetlands, we are still suffering irreplaceable losses. We no longer make attractive offers to get potential developers to ditch and drain every square inch of our swamps. We certainly know and understand the consequences of such activities. Yet, wetland losses are proliferating. And while our weltand losses are increasing, government agencies that purport to protect the resource are growing in number as well. It would appear that in spite of their proliferation, the agencies are greatly ineffective in protecting the wetlands.

One of the problems appears to be the lack of assessment of cumulative impacts which has resulted in narrow determinations and piecemeal destruction of our large system. The Everglades has been subjected to cumulative degradation by flood control projects and drainage, much of it completed prior to a basic understanding of the system. This remnant system must now process more water than ever for human uses, and still be able to provide for the Everglades National Park at the bottom end.

While we are attempting to understand and correct the mistakes of the past, we must at the same time attempt to prevent mistakes of the future. We are overloading the system in terms of being able to provide clean, unpolluted water and at the same time remove floodwaters that may threaten lives of both humans and wildlife. All life in South Florida depends on the working of this process. We can see our losses in terms of wildlife. Our wading bird population has been decimated. We have gone from 1.5 million birds in 1935 to an estimated 150,000, and this figure is contaminated with counts that probably include the cattle egret which has moved into the populated portions of the State.

To give a simple example of the narrowness with which decisions concerning wetland destruction are made, let me address wood storks. Wood storks have decreased

over 80% from 1967 to 1982 because of the mistakes in maintained water levels which have prevented successful nesting. They have managed only 2 successful nesting years in 18 years. They are critically endangered at this point and some have proposed that within the next 10 years or so the population in Florida may be gone because there will be too little wetland habitat left for them to exist. In spite of this, individual permits for wetland destruction in areas where it is documented that woodstorks are seen are approved with the simple conclusion that this one habitat is not going to be the "last straw". The same is true of the Everglades kite. The same is true of the Florida manatee.

When will we pile on that last straw? Do we want to go that far? Will it be recognized prior to the extinction of this wildlife? Will the destruction of our water resources for humans bring us to a point where people will have to move elsewhere because the system can no longer support them, or because they can no longer afford to pay the price for water to drink? Will people have to settle for lower quality water, or learn to live with less?

Signs already are here that indicate we may be rapidly approaching the point of no return. We have allowed considerable contamination of our underground water supply to occur, water conservation measures are called for on a fairly regular basis, reuse of water by spray irrigation of waste water and other such measures are prompted, saltwater continues to move inland forcing the movement of drinking water wells even farther inland, and the incredible loss of wildlife (especially wading birds) should more than indicate the critical state we are now in.

The federal government, we believe, should be making an assessment of the efficiency of their permitting processes concerning dredge and fill activity. Given the fact that the Army Corps of Engineers determines whether someone will be allowed to destroy one of the links in our system of waters, is the Army Corps of Engineers protecting the public from the harm that will result if our water supply is forever compromised? Decisions which state that this one small project will not be the "last straw" are made daily without any knowledge as to whether it will ultimately prove to be just that.

We have permitting agencies at the federal, state, regional, and local levels. None of these agencies has the benefit of current knowlege concerning cumulative losses. None of these agencies has the benefit of current studies which define the function of remaining wetlands and whether they are critical to the future of Florida. None of these agencies know the cumulative loss. None of them have assessed the effectiveness of their regulations. It is critical to our future that all of the agencies cooperate in an investigation of the remaining system and determine what we need to do to correct our past mistakes and protect and restore the remnants that we have left.

It was determined some years ago that the United States as a whole is losing vital wetlands and can no longer afford to do so. Florida has been a leader in the loss of wetlands, as mentioned above. We must now begin to determine how we can restore those wetlands that are on the threshold. The western C-9 basin is on the threshold, and would be an effective case study. It has been seriously degraded. We must not allow such losses to proliferate, but instead must determine how we can correct the mistakes and reverse the trend in wetland loss. The addressing of cumulative impacts is vital in making permit decisions which determine future land uses in wetland areas, and the Army Corps of Engineers is deeply involved in making such determinations.

Florida needs to protect and manage the wetlands it has left and can only do this with adequate knowledge and understanding of the system. It needs to stop the loss and repair and upgrade the remnants it has left. Determinations as to what functions various wetlands serve or are needed to serve, and determinations on how to improve what they do must be made if we are to reverse the trend.

So, in summation, the Environmental Coalition suggests that all levels of government need to cooperate in an effect to define the wetland system of the Everglades as all levels of government make determinations concerning this system through their permitting process. Our local concern, of course, is with the C-9 basin which is currently being irretrivably threatened by a permit application at this time. Relying on data supplied by applicants is not an effective substitute for indepth studies of the system as a whole. The applicant is only interested in the effects on his property, not the system.

Further, we suggest that the first step in the process should be an evaluation of the effectiveness of each agency's program in protecting and enhancing these waters of the United States. Only then can informed decisions be made. Of utmost importance in this process is the fact that future decisions regarding wetland systems must be based on what will happen to that system, not what will happen to the

applicant. Unless we know what we are dealing with, we cannot make the decisions that are needed to protect this system and prevent irreversible to all.

Thank you again for this opportunity to express our concerns, and to offer suggestions to you today.

STATEMENT OF JOSEPH E. PODGOR, JR., FRIENDS OF THE EVERGLADES

Mr. Chairman, and members of the Committee, my name is Joseph E. Podgor, and I serve as the Dade County Chairman of Friends of the Everglades. Friends is a private, nonprofit, membership organization that serves as an advocate for the Everglades system: for it's restoration, conservation, and preservation. We appreciate the opportunity to appear before this distinguished Committee today.

The Everglades is the centerpiece in the South Florida Regional Watershed System, a system that starts in the headwaters of the Kissimmee River, flows south into Lake Okeechobee, overflows into canals serving estuaries on both the east and west coasts, and then continues downstream through the "River of Grass" and the Mangrove Forests until this precious fresh water seeps finally into Florida Bay at the southern end of the peninsula. Along the way this liquid center of Florida is tapped by huge farming areas for irrigation, drained off for flood protection through some canals, and conveyed through others to the urban coast to recharge the underground drinking water supplies of our burgeoning cities. The consumer demand placed on this water is increased by the 500–700 people who have been moving to South Florida each day to stay on as residents.

I am here today with mixed emotions. I would like to report to you that all is increasingly well with this important natural system. The nation's growing environmental awareness of the 1970's, and the many federal and state programs of both the 70's and the 80's surely should have had such a profound effect by 1988 that the Everglades System would by now be truly "saved."

We had the Federal Pollution Control Act (now the Clean Water Act) that aimed toward making the waters of the country "swimmable and fishable" by 1985. We saw a Federal Safe Drinking Water Act in the 70's promise protection to "sole source aquifers" as designated by the Environmental Protection Agency.

We had a national understanding and commitment to the protection of wetlands throughout the country as being a highly important public trust. We vowed to halt the loss of these vanishing resources unless the loss was permitted as an act which provided overriding benefits in the public's interest.

And above all, we displayed the good sense to develop a policy (NEPA) which required Environmental Impact Statements for major federal actions so that decisions affecting our scarce natural resources would be firmly based on the strength of knowledge backed by observed data.

As I began, I would've liked to report that all is well now with the only Everglades we have on this earth. But that is not the case. Although great strides have taken place on paper, there is much work to be done, and some undone, if we are to actually live up to the promises of the past two decades of federal water management endeavors.

It is now 1988 and we cannot safely swim nor eat the fish we catch from our urban waterways, even though our state with EPA approval has designated them for that purpose for over ten years. A National Pollution Discharge Elimination System operated by EPA has failed to require permits for a myriad of private commercial wastewater discharges draining the Everglades Agricultural Area and other farm areas in such a way as to lead to the current crisis which now threatens the complete destruction of Lake Okeechobee.

I, along with six colleagues including Marjory Stoneman Douglas, petitioned successfully in the late 70's to get the EPA's designation of the Biscayne Aquifer as a special "Sole Source" under Section 1424(e) of the Safe Drinking Water Act. Our goal was to protect our fragile underground drinking water supply from damaging projects which involved federal assistance.

However successful our petition, the aftermath was a complete failure. EPA refused to intervene in such projects as the South Florida Regional Jetport at Site 14 (an FAA funded plan which would have put a 35 square mile airport over the last clean wellfield for a million consumers). Nor would they interfere in the routing of Interstate Highway I-75 through vast wetlands in western Broward, duplicating a parallel, four lane U.S. 27, a traditional route which could have served the same purpose saving the wetlands and many millions of dollars. While a local and state consensus was ultimately responsible for the defeat of the Jetport plan (over the perseverance of the FAA), the I-75 route became reality providing inducement to

the draining and filling of Browards' only remaining East Everglades areas. Now in place of clean recharge areas for the groundwater needs of coastal communities, the highway has ensured that contaminating developments and even a landfill will replace all the wetlands that remain.

Where once existed a belief that federal policy was to halt the loss of wetlands, we aer now faced with an Army Corps of Engineers which is more concerned with not inconveniencing developers than they are with protecting this resource. We are now faced with odious "National Permits" which allow the complete destruction of wetland parcels of less than 10 acres without the opportunity for public notice, hearings, or comments.

Our local Corps district has been trying to find a way to issue a "General Permit" for the filling of wetlands in Southeast Florida for the past six years and may now have found a way. We were recently informed by the Jacksonville District that a general permit (which under the Clean Water Act is for matters of little environmental consequence) can be now justified for filling large wetland areas if there is "mitigation" which offsets the damage to the public interest this destruction entails. They suggest that dedicating for full protection another wetland area, offsite, may be sufficient to make up for the losses in the permitted "fill" area.

Unfortunately, this tactic as applied in Dade County's East Everglades fringes, results in a net loss of valuable wetlands in a location critical to drinking water provision. This same area has been proclaimed by the land owners as being under intense "development pressure." The reluctance of all federal agencies to get involved in local land use questions is no keener than in the overworked permitting sections of the Army Corps of Engineers. The national commitment to saving wetlands is lost in the Corp's effort to make them available for the demands of land speculators and developers with a minimum of paperwork.

While otherwise non-permittable projects are being allowed with "mitigations" which do nothing to halt the net loss to the nation's wealth of wetlands, we have another problem in the practice employed by both the Corps and EPA in avoiding at all costs the Environmental Impact Statement. This provision of the National Environmental Policy Act has been our one clear assurance that major federal actions would be publicly scrutinized for their effects on our natural resources.

And yet these agencies routinely declare that such a study is not required for some of the most critical federal permitting actions. At one point seven separate permits covering nearly 1500 acres of wetlands in the heart of Dade County's largest drinking water wellfield were simultaneously reviewed by the Corps, and repeated requests for public hearings and an EIS were denied. Nor could EPA be cajoled into pressing the matter, even though all involved conceded that the water supply in question was the last pristine source available for a million users.

The movement of water through the Everglades is as important as the actual presence of it there. It must be available at certain times of the year and not at others if the huge variety of birds, plants, and animals are to breed and flourish. The water must move through marshes to cleanse itself and to transport essential nutrients through the basin. The balance is a delicate one, and yet it is a balance nature provided without our aid for millennia.

The Everglades and all who depend on it have suffered severely from the human tinkering that has now threatened the chance of preserving even a remnant of the original Everglades in our National Park. This tinkering comes in the form of water level scheduling and the deliberate discharges of water by a cooperative effort of the South Florida Water Management District and the U.S. Army Corps of Engineers.

Threats to the natural systems of this watershed include the discharge of excess nutrients from farming wastes being sent to either Lake Okeechobee or the partitioned Water Conservation Areas, water levels in the basin being regulated so as to not mimic the natural levels needed for proper estuary mixes or animal needs, and levels being held so artificially high that the Lake teeters on the brink of ecological collapse for the sake of reserving extra water for the sugar fields to the south.

Again, the balancing act of considering economic along with environmental considerations in management decisions has proven to be best an exercise on paper. In the field, this federal and state "management" may kill the goose that lays the golden eggs such that there will be no benefits at all in the end. The health of the system must be the primary consideration and should be so specified in all Congressional water guidelines if we are to continue to enjoy the use of these waters. A dead Everglades, a septic Lake Okeechobee, a lifeless Kissimmee Valley, fishless estuaries, and contaminated aquifers are the ultimate results of managing South Florida's water resources as it is practiced today.

Friends of the Everglades and our colleagues in many citizen organizations throughout our growing state are all the while encouraged by the great strides Con-

gress is making in the public acquisition of wild lands in our region. This effort may be the single, most effective action taken at any level of government for the ultimate establishment of a self-regulating, full-functioning remnant of the Everglades. But while we buy and swap land to reassemble ths unique system, we must simultaneously refrain from damaging the very lands we buy. Mere ownership without care for our actions will not preserve or protect this rare system. We need refined mechanisms for enforcing the resolve of Congress which so nobly intended to care for these water resources.

Our wetland protection laws must be made to protect wetlands, not just allow the destruction to continue in a measured and contrived way. Our pollution elimination system must eliminate pollution, not just allow it's continued assault on the nation's waters with a wind and a permit. Our drinking water protection efforts must become courageous enough to embolden timid agencies like the EPA to speak up when clear and calamitous threats to the public's health are at hand. And water management decisions must maintain the health of the natural system as a first priority, if we are ever to provide for future generations.

Mr. NOWAK. Thank you very much. Let me, before I make my remarks, let me yield to my colleagues because they may have airplanes or other commitments right way.

Mr. Stangeland.

Mr. STANGELAND. Well I want to thank this panel and I want to make the same request for this panel as I made of the last two panels, that I submit my questions in writing, because I do have a plane to catch.

But I want to thank you. I recognize and I think many members of Congress recognize, Mr. Shaw and Mr. Nowak, that the next crisis we face in this country, is a crisis of water. And we have to be very concerned about it. I think I alluded to those bills that you talked about before, and my concern, coming from an agricultural area, is that it is in agriculture's interest to have clean water and we in rural areas depend on that groundwater for our water supply very much.

But I want to know, and this is the purpose of these hearings, what is the problem, what are responsible solutions to the problem, how do we do it, who is causing the problem and the whole thing. And I think sometimes to act in haste—and I have seen Congress do that on occasion, means to go back and redo. But to drag your feet and not act at all is equally as offensive, and I appreciate some of the remarks you have made here and your concerns and I think I am very pleased with this hearing. I hope you are. We came out here to hear firsthand and I think we have gotten some answers. I am somewhat confident that the people concerned with the problem; south Florida, the Corps, EPA, are doing a fairly good job. Maybe not as good as you would like to see and maybe we can get them to do better, but you know, they respond to us. A lot of times the Corps gets a bad rap for doing some horribly bad things, but the Corps only follows up on things some local people have started by having Congress tell the Corps to do it. I have found the Corps in my area to be very responsive.

In fact, as far as general permits, we have been trying to get a general permit on a drainage problem there on agricultural land and I have not been successful.

Mr. NOWAK. Thank you very much. Larry Smith had contacted us about this problem and he also expressed his concern about the whole area and has submitted a statement for the record because

he unfortunately had a previous commitment. So we will accept that statement.

[The statement of Mr. Smith follows:]

STATEMENT OF HON. LAWRENCE J. SMITH

Florida's Kissimmee River, Lake Okeechobee and the Everglades act as national symbols of threatened environments. Although these environments are unique to the State of Florida, the battle to preserve these sensitive environments certainly is not unique, and every state stands to benefit from Florida's experience.

Relentless efforts by the State of Florida and the Florida Congressional delegation will inevitably act as a national blueprint for environmental policy. By sharing the knowledge gained in the efforts to preserve the Kissimmee River, Lake Okeechobee and the Everglades, Florida will be able to educate other states on the warning signs of impending environmental degregation and methods to avoid irreparable damage.

Florida Congressmen and Senators have worked diligently to make these Florida concerns, national concerns. The Federal Government, as well as the State of Florida, must continue to work in unison to prevent further damage to these unique areas. The Kissimmee River, Lake Okeechobee and the Everglades will only by distant memories if we do not act now to protect these valuable resources. I will continue to join my Florida colleagues in pursuing federal legislation which will provide these Florida environments with the much needed protection that they deserve.

Mr. NOWAK. I would like to place in the record at this point the statements of Representative Bill Lehman and Representative Dan Mica.

[Statements referred to follow:]

STATEMENT OF HON. WILLIAM LEHMAN

Mr. Chairman, I appreciate your giving me this opportunity to express my support for the restoration of the Kissimmee River in Florida.

I know that other witnesses will describe the history of this unique Kissimmee River-Lake Okeechobee-Everglades ecosystem. It is indeed unfortunate that in the 1960's the U.S. Army Corps of Engineers' channelization of the Kissimmee River has had such an adverse impact on this natural ecosystem. Now, however, our efforts must be directed toward repairing this massive environmental damage.

In 1984, the South Florida Water Management District began its project to restore the Kissimmee River. Fortunately, section 1135 of the Water Resources Development Act of 1986 contains language which allows the Army Corps of Engineers to modify existing projects to improve the quality of the environment. I am very supportive of the reauthorization of this provision, and the use of funding under section 1135 for the restoration of the Kissimmee River.

As a member of the Appropriations Committee, I have consistently supported efforts to provide funding for the Kissimmee project. Two million was provided in FY'88, and the Energy and Water Appropriations bill for FY'89 includes $300,000 for the Kissimmee.

South Florida is different from other areas in that the water supply is rainfall driven. The water of the Kissimmee River contributes to the Biscayne Aquifer, and therefore this Kissimmee River-Lake Okeechobee-Everglades ecosystem plays an important role in providing a safe water supply for about four million people in South Florda. In addition, this ecosystem is instrumental in creating an environment where fish and wildlife can thrive.

Again, thank you for giving me this opportunity to testify. I appreciate all of the past efforts of your Subcommittee, and look forward to your continued assistance.

STATEMENT OF HON. DANIEL A. MICA

Mr. Chairman, I congratulate you on recognizing the need to evaluate Florida's unique ecosystem. I am pleased to have the opportunity to testify on the critical issues surrounding Florida's water resources.

As you know, Florida, and South Florida in particular, is faced with an incomparable situation. The Florida ecosystem is completely intrastate. The problems faced by one element of the system has direct impact upon the other aspects of the system.

Referred to as the Kissimmee-Okeechobee-Everglades system, the inter-relationship of the major portions of the system are implicit. For example, when critical decisions are made regarding the Kissimmee River, the impacts on Lake Okeechobee and the Everglades must also be evaluated.

As you know, Lake Okeechobee is the greatest provider of fresh water to South Florida. The residents of South Florida have a vital and complete stake in the preservation of Lake Okeechobee. The problems facing the Florida ecosystem have been further heightened by the rapid development of South Florida. Add to this the fact that the channelization of the Kissimmee River supposedly solved a problem. Now it is known that channelization was ineffective, and it actually caused more problems than it solved. To further complicate the entire situation, the waters of the area are polluted by agricultural run off.

Because the Florida ecosystem is an intrastate ecosystem, the State is dependent upon the expertise of the Federal government. But, as we have seen in the past, this expertise must be closely monitored in order to prevent both abuses and neglect. Economically, Florida also must rely upon the Federal government as the State confronts its environmental problems.

As I have said, there must be a joint Federal-State effort to preserve and protect our ecosystem. Unfortunately, the Federal government has made mistakes in the past which we continue to pay for today. The money, time and energy that have been devoted to confronting the problems of the Kissimmee River since the channelization project was implemented by the Army Corps of Engineers have been immense. Indeed, the entire area continues to pay for this channelization project. The impact has been felt economically and environmentally.

A concrete example of the effects can be seen today in the Everglades. The area now known as Everglades National Park is only a fraction of the area that once made up the Everglades. The entire area was once populated be wildlife, and vast grasses and flowers. Now our energies are spent trying to preserve what has not yet been destroyed, and to redevelop the area. For example, we regularly try to prevent the premature death of deer. And water levels in the area must be monitored in order to preserve botanical life.

Water management is critical. We must learn from past mistakes. Indeed, so called water management policies instituted by state and federal agencies have caused great damage, some of which may be irreversible. The ecology of the Everglades has been forever changed. We must now fight water pollution, and work to reverse the trend of elimination of vegetation, wildlife and marine life. According to William J. Schneider and James H. Hartwell, in their 1984 article "Troubled Waters of the Everglades" which appeared in *Natural History*, "Undoubtedly the most damaging effect of water management has been the intentional cutting off of the traditional flow of water from Lake Okeechobee to the southern part of the Everglades."

Many of the problems that we are working to correct were man made. We are working together to overturn past mistakes, and to protect our environment from further harm. Simultaneously we are attempting to correct the existing damage.

We must work together to address the environmental issues. This means encouraging further attention, as well as fighting for additional funds. We must devote ourselves to protecting our precious resources.

Mr. NOWAK. Mr. Shaw.

Mr. SHAW. Thank you, Mr. Chairman. I would like to again thank you for coming down. It has been a long day, we have worked hard. That flight over the Everglades was anything but a luxury first-class flight, I can tell you. It was like sitting inside a steaming tube, but it was a great learning process. Today has been a great learning process. I thought I was bringing our friends from Washington down to share with them looking at a problem and indeed we have done that, but in doing so, I have found a greater problem that I knew existed. I have found details of this problem that I did not know existed.

In listening to Mr. Finley talk about the problems down at the south end of the park that I did not know about, Mr. Creel talking about the problems up in the north end, it is pretty conclusive that the cattle industry is creating some real big, big problems.

I think as all of us here on this subcommittee, certainly those of us here today, are very strong advocates of the rights of private property but that certainly does end at the water's edge and one's rights do end where it starts interfering with such things as the right to clean water. I am somewhat terrified at this point as to what exactly is going on in Lake Okeechobee. It may very well be a time bomb. I am very concerned as to whether or not plans are going forward. It is nice to be talking about these things, but we had better get something started, we had better stop that pollution while we are looking for the solution of how to clean up what we have.

Joe, I can say to you in defense of the Corps, the other side complains about you too. So I think when you have both sides complaining about you, there is probably a balance there that neither side is happy with. But the environment here in south Florida is different from a lot of places and I think we have to address the issue, we have to address it headon, we definitely have a federal responsibility here.

I want to thank this panel of witnesses for some very fine testimony. You spoke of having to lobby governmental agencies, that is what you are about, that is the way our process works and I hope that you will continue, because I can assure you that those who naturally want to further their own private interests are certainly going to be exercising their rights to lobby also.

We have got a great community down here and I think as this Subcommittee has found out, we are very concerned about the environment here in south Florida and we have got some great minds that are willing and anxious to join the Federal Government in coming up with the solution. We have got some good people in the South Florida Water Management District that I think are readily facing up to the problem. But we have got to address this as a crisis and I think that—Joe, I think you said it, let us not start making the funeral plans yet, let us figure out how to save the baby. And by the way, I think Solomon was going to cut that baby in half if the real mother did not come forward and tell him not to. [Laughter.]

Thank you, Mr. Chairman.

Mr. NOWAK. Thank you, Clay. And let me just express our appreciation to Clay, who has literally been on my back for months to come down here to take me on an airplane ride to view this entire ecosystem. [Laughter.]

But we have had a great time. I had some feeling for this area because I have been down here several years before with my family at Easter time. Knowing the sensitivity of this, I have also spent some time in the Everglades National Park and have gone down to the Keys and know the kinds of concerns that have been expressed over the years in trying to maintain the best we have in our environment. I think, you know, everybody has, over the last seven or eight years or so, a new awareness of what our total environment means to us throughout the country and certainly the importance of these very sensitive areas and very tenuous areas like this southern area of Florida. You know, we have just got to go that extra mile to make doubly sure now that we preserve the best of what we have to offer our children.

I might just mention communication, you know, the more intelligent input and the more broad that input can be into the various federal agencies is having a much broader effect than it used to. And if you can get that input into the agencies in time and do it intelligently, I think all the environmental groups that have formed, have taken perhaps their task from the initial movement years ago that shot broadly, now are getting the time and the talent and I think you three here represent that very well, to get better input into the Corps so that they can really make a valid determination on some of these questions.

That is not always going to work and that is why of course you have a Clay Shaw here in southern Florida, and an Arlan Stangeland up in Minnesota. But we are in an area where state-of-the-art has not really caught up with the problem, with the vastness of this problem. We are trying to play catchup ball and that is why I think we have got to all work together. There are so many environmental laws out there and just by today's relatively narrow hearing in one little part of the environmental laws, you can see the separation of interest in the institutions, and we have not even had here the input from the agricultural interests into this hearing and see what they are doing and how they are cooperating with the State because it is almost an impossibility when you spend a lifetime in one narrow area and still not know it all.

So I think this hearing has been very helpful. We hope that we have added something to it, perhaps a broader awareness of what the consequences could be if, you know, we do not get that cooperation right from the bottom to the top in this area, and certainly we want to have the federal people respond and I am sure Mr. Shaw will be ready and able to assist and will more than welcome your input as this problem progresses, and hopefully solutions start to become clear.

Now we will again keep the record open and if there is any other information any of the witnesses that have come before us would like to submit in addition after hearing other witnesses, we would welcome that also in trying to put together a total report for the rest of our colleagues and for our consideration as we move into the future now, into the next stage of environmental protection and try to look at these problems in the best possible way to handle it. We did not touch upon the sediment problem but that is going to be a huge, huge problem for EPA to try to get into, not only here but throughout the country where heavy metals and lead and dioxin and everything else is sitting on the bottom of not only our Great Lakes, but I think a majority of our lakes throughout the country.

But again, we are not there with the solution yet. We have not developed that.

I want to thank you for your input into the hearing, I know it takes time. We look forward to working with you in the future.

[Whereupon, at 4:55 p.m., the subcommittee was adjourned.]

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